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A MONOGRAPH

OF

B R I T I S H

CRETACEOUS BRACHIOPODA.

BY

THOMAS DAVIDSON,

MEMBER OF THE GEOLOGICAL SOCIETY OF FRANCE.

PART II.

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22. TEREBRATULA BIPLICATA, *Brocchi*, Sp. Plate VI, figs. 1—49, and Plate IX, fig. 40?ANOMIA BIPLICATA, *Brocchi*. *Conchologia fossile*, p. 469, pl. x, fig. 8, 1814.TEREBRATULA BIPLICATA, *Sowerby*. *Min. Con.*, vol. i, p. 201, tab. 90, 1815, and vol. v, p. 53, tab. 437, fig. 2, 3, 1825.— — *Parkinson*. *An Int. to the Study of Organic Remains*, p. 227, 1822.— OBTUSA, *Sow.* *Min. Con.*, vol. v, p. 53, tab. 437, fig. 4, 1825.— BIPLICATA, *DeFrance*. *Dic. des Sciences Nat.*, vol. liii, p. 151, 1828.— — *Woodward*. *A Synoptical Table of Brit. Organic Remains*, p. 21, 1830.— — and T. OBTUSA, *Brown*. *Illustrations of Fossil Conch. of Great Britain*, pl. lii, figs. 27, 28, and pl. liv, fig. 25, 1835.— FABA, *Sowerby*. (*in Fitton*). *Trans. Geol. Soc.*, vol. iv, p. 338, pl. xiv, tab. 10, 1836, (not *T. faba*, *Sow.* d'Orbigny, *Pal. Tran.*, vol. iv.)— BIPLICATA, (part) *Von Buch*. *Class. des Térébratules*, *Mém. Soc. Géol. de France*, vol. iii, p. 219, 1839.— BIPLICATA and OBTUSA, *Morris*. *Catalogue*, 1843.— DUTEMPLEANA, *D'Orbigny*. *Pal. Franç., Terrains Crétacés*, vol. iv, p. 193, pl. 511, figs. 1—8, 1847.— BIPLICATA, (part) *Bronn*. *Index Pal.*, p. 1230, 1848.— — and OBTUSA. *Catalogue of the Terebratulæ*, in the *British Museum*, pp. 23, 24, 1853.— — *Sharpe*, *Quart. Journ. Geol. Soc.*, vol. x, p. 191, 1843.

Diagnosis. Shell oblong, oval, somewhat pentagonal: ventral valve convex, and in general deeper than the dorsal one, which is more or less prominently biphiculated; beak short, rounded, incurved, and obliquely truncated by a circular foramen of moderate dimensions. Deltidium very narrow, and generally inconspicuous from the aperture being contiguous to the umbo of the dorsal valve: lateral margins flexuous, bisinuated in front; surface smooth, marked by concentric lines of growth, and at times obscurely striated on the sides; loop simple, not exceeding one third of the length of the socket valve. Dimensions variable; length 23, width 16, depth 11 lines.

Obs. It was not until after much consideration and repeated comparisons of more than three thousand examples, that I could make up my mind to refer to a single species the *biphiculated terebratulæ* illustrated in Plate VI. of the present monograph.

The term *Anomia biphicata* was first introduced by Brocchi for a cretaceous terebratula from San Quirico, in Tuscany; no description was appended, but the figure then published represents a smooth, oblong oval, or somewhat pentagonal shell, 14 lines in length, by 9 in breadth, notched or biphiculated towards the front, with a slightly incurved beak, circular foramen and inconspicuous deltidium. Nothing more appears to be known of this Italian shell except that the same locality is mentioned for *Rh. vespertilio*.

One year after the publication of Brocchi's work, Sowerby described, under a similar denomination, a biphiculated terebratula, common in the *Gault* of Folkstone, and *Upper Green*

Sand, near Warminster, Cambridge, and other localities, and these have been generally admitted to be the types of *T. biplicata*.¹ M. D'Orbigny seems, however, to consider the Italian shell specifically distinct from our British one, not from a personal acquaintance with Brocchi's type, but from an assumption of his own; nor have I been more fortunate in my endeavours to obtain additional information regarding the San Quirico fossil, all we are therefore enabled to judge from, is the figure, and this so nearly agrees with many of the forms found in the *Upper Green Sand*, near Warminster, that strong doubts may be entertained whether the French author's opinion be really correct.² The illustrations furnished by M. D'Orbigny, (Pal. Franc., Terrains Crétacés, vol. iv. pl. 511, figs. 9—15,) resemble, in my opinion, the Italian figure far less than some of those of which he forms his *Ter. Dutempleana* (same work, Pl. 511, figs. 1—8,) and to this last, he justly refers Sowerby's figures of *Ter. biplicata*.

No species varies to a wider extent than the one under consideration, but, at the same time, it does not seem difficult to trace the links which connect by insensible gradation the most extreme variations hitherto observed; nor am I yet prepared to surrender the opinion expressed in page 53, viz. that passages may not be found similarly connecting these last to the *Ter. obesa* (Sow.).

Local conditions have materially influenced the regular development of this, as well as that of other forms; producing varieties and races, not always easily referable to their original type. Thus, when young, *Ter. biplicata* is perfectly oval, uniformly convex, and without trace of biplication, but as the animal advances in its development, the dorsal valve becomes more or less prominently biplicated, with a mesial sinus of variable depth and width extending between the plicæ; but, in some examples, the regular convexity of the dental valve is but slightly influenced by the *biplication* of the dorsal one. These differences may be observed in the numerous illustrations in Pl. VI, and especially in figures 5, 9, 17, 36, &c. Much variation is likewise produced in the general contour, by the lesser or greater approximation of the two plait and their ridges, as well as by the different degree of convexity presented by the valves.

Two principal varieties may be mentioned.

1. The one abundantly found near Warminster, and in the Isle of Wight, of which

¹ Sowerby mentions the *Gault*, at Cambridge, as containing his *Ter. biplicata*, but it would appear that the shell, although common in the *clay band* of that name at Folkstone and in other localities, at Cambridge is only found in the *Upper Green Sand*. As justly observed by Mr. Deshayes, many other biplicated species from the oolitic and other formations have been confounded with the cretaceous type: thus Professor Bronn mentions as synonyms of *Ter. biplicata*, (Index Pal., p. 1230), the following forms which seem all specifically distinct. *Ter. bicanaliculata*, *T. maxillata*, *T. sella*, *T. Harlani*, *T. bisuffarcinata*, and *T. perovalis*. V. Buch has likewise erred in several of his supposed synonyms of this species, but was right in placing *Ter. faba* among them.

² In page 53 of this Monograph, published in 1852, I had so far sanctioned M. D'Orbigny's view by admitting the name *Ter. Dutempleana*; but subsequent and more complete investigations disposed me to consider that conclusion both premature and uncertain.

figs. 33 to 44, are examples. This form approaches most to the Italian figure, and should be looked upon as the more typical shape. M. D'Orbigny's illustration, *Pal. Franc., Terrains Crétacés*, vol. iv, Pl. 511, figs. 5, 6, 7, is likewise referable to this form. *Ter. faba*, Sow. is simply a dwarf *Terebratula biplicata* from the Upper Green Sand of Warminster.¹

2. Those wider and more flattened shapes commonly met in the Gault of Folkestone, and Upper Green Sand of Cambridge, (Pl. VI, figs. 1 to 9, 12, 29, &c.) in these the two plaits are much more widely separated, and to it, M. D'Orbigny's illustration, *Pal. Franc., Pl. 511, fig. 1*, may likewise belong. This is the variety I had intended to retain as *Ter. Dutempleana* (p. 53) and No. 1, as *Ter. biplicata*, (Brocchi,) a view I now abandon for the reasons already specified.

Ter. obtusa, Sow. (Pl. VI, figs. 10, 11, 13, &c.) is only a variety of *Ter. biplicata*, or *Dutempleana*, in which the shell has extended more in width than in length, and wherein the biplication has either entirely disappeared (figs. 10, 11,) or exists simply in a rudimentary state, (figs. 13, 23), but that this is simply an unusual condition of the species has been amply proved by a series of upwards of a thousand examples collected by Mr. Carter, at Cambridge, and in which every passage may be traced uniting such extreme forms as figs. 3, 6, and 10.

It seems difficult, in the actual state of our knowledge, to specify with certainty the precise period at which *Ter. biplicata* made its first appearance, but, if some shells (Pl. IX, fig. 40) lately discovered by Mr. Mackie in the highest bed of the *Lower Green Sand* series at Folkstone, really belong to this species, they would be the oldest examples with which we are acquainted.

Ter. biplicata occurs in the *Gault* of Folkstone, the *Speeton Clay* of Yorkshire; and the *red chalk* of Hunstanton; it abounds in the *Upper Green Sand* of Cambridge, in the neighbourhood of Warminster, at Farringdon; and although less common, still seems to be represented in the Chalk marl and Lower Chalk of Cambridgeshire:—thus having a wide vertical range, extending almost through the entire cretaceous system.

On the Continent, it occurs at Wissant, in the *Gault*, and in many of the *Upper Green Sand* localities of Europe.

Plate VI, figs. 1 and 2. *Ter. biplicata* var. *Dutempleana*, D'Orb. from the *red chalk* of Hunstanton, in the Collection of Mr. Fitch.

„ figs. 3, 4, 5. A large specimen from the *Upper Green Sand* of Cambridge, in the Cabinet of Mr. Carter.

„ fig. 6. A remarkable example from the same locality and collection, showing traces of coloration.

¹ Professor Forbes states, in his catalogue of the *Lower Green Sand* fossils, *Quart. Journ. Geol. Soc.*, vol. i, p. 346, "*T. faba* (Sow. in Fitton, t. xiv, fig. 11). The original specimen is in the Geological Society's collection, and is from the Upper Green Sand of Warminster; it appears to be a young or starved state of *T. biplicata*, or some allied species."

Plate VI, fig. 7. Interior of the dorsal or socket valve with its loop, from the same collection and locality; figures 10 to 28, and 31, are all from Mr. Carter's Collection, and neighbourhood of Cambridge.

- „ figs. 8, 9. Another Upper Green Sand specimen from Cambridge.
- „ figs. 10 to 13. Different examples and ages of the variety (*Ter. obtusa*, Sow.) from Upper Green Sand, of Cambridge.
- „ figs. 14 to 28. Other examples of different shapes and ages from the same bed and locality.
- „ figs. 29, 30. *Ter. biplicata* from the Gault of Folkstone.
- „ fig. 31. A specimen from the lower chalk near Cambridge.
- „ fig. 32. Another from the Lower Chalk of Lewes, in the Cabinet of Mr. Catt.
- „ fig. 33. An elongated example from Warminster, in the Museum of Practical Geology.
- „ figs. 34 to 42. *Ter. biplicata*, a short inflated variety from near Warminster, in the Collection of Mr. Cunningham.
- „ figs. 43, 44. id. (*Ter. faba*,) Sow.
- „ figs. 45 to 49. *Ter. biplicata*? stated to have been found in Lower Green Sand, near Devizes, by Mr. Cunningham.

Plate IX, fig. 37. A specimen from the Upper Green Sand of Farringdon, in the Collection of Mr. Sharpe.

- „ fig. 40. A specimen of *Ter. biplicata*? from the highest bed of the Lower Green Sand series in the vicinity of Folkstone, Collection of Mr. Mackie.

23. TEREBRATULA PRÆLONGA, Sowerby. Plate VII, figs. 1, 2.

TEREBRATULA PRÆLONGA, Sowerby (*in Fitton*.) Trans. of the Geol. Soc., vol. iv, p. 338, pl. xiv, fig. 14, 1836.

— BIPPLICATA, var. ACUTA, *V. Buch.* Class. des Térébratules, Mém. Soc. Géol. de France, vol. iii, p. 220, 1834. (Not *T. biplicata*, Brocchi, nor Sow.)

— PRÆLONGA, *Brown.* Illust. of Fossil Conch., pl. liv, figs. 8, 10, 1838.

— BIPPLICATA, *Leymerie.* Mém. Soc. Géol. de France, vol. v, p. 29, (not *Brocchi*,) 1842.

— PRÆLONGA, *Morris.* Catalogue, 1843.

— — *Forbes.* Quart. Journ. Geol. Soc., vol. i, p. 345, 1845.

— — *D'Orbigny.* Pal. Franç., Terrains Crétacés, vol. iv, p. 75, pl. 506, figs. 1—7, 1847, and Prodrôme, vol. ii, p. 85, 1850.

— — Catalogue of the *Terebratulæ* in the British Museum, p. 28, 1853.

Diagnosis. Shell of an elongated oval shape, with almost equally convex valves; beak prominent, not much incurved, obliquely truncated by a large circular foramen, partly

surrounded by, and widely separated from the hinge line by a deltidium in two pieces; beak ridges undefined, lateral margins flexuous, slightly raised and bisinuated in front. The *dorsal* or socket valve is biplicated towards the front; surface smooth, with a few concentric lines of growth. Loop short, not exceeding a third of the length of the dorsal valve; shell structure minutely punctated. Dimensions variable; length 18, width 12, depth $9\frac{1}{2}$ lines.

Obs. This species appears to be readily distinguished from *Ter. biplicata* by its very elongated oval shape; the cardinal half becoming considerably lengthened, gives the shell a somewhat scuttle-shaped appearance: while, on the contrary, *T. biplicata* is more pentagonal and rounded near the beak; the last becoming incurved, with the foramen situated so close to the hinge line, as to render the deltidium almost inconspicuous. Some exceptional examples might perhaps be obtained connecting the two forms, but these not having yet been procured, we must continue to consider this species as distinct.

Ter. praelonga appears to characterise the *Lower Green Sand* (*Néocomien* of the French), while the *Ter. biplicata* chiefly occurs in the *Gault* and *Upper Green Sand*.

T. praelonga was well figured by Sowerby in 1836 from a specimen stated to have been found in the *Lower Green Sand* of Sandgate (Kent); it occurs likewise near Maidstone (Kent), and in other localities; but it is one of our rarer British species.

On the Continent, M. D'Orbigny mentions it from the Lower *Néocomien* beds of Baudrecourt, Bettancourt-la-Ferrée (Haute Marne), Morteau (Doubs), the neighbourhood of Castellane and Marolles (Aube), at Neuchâtel in Switzerland, &c.

Plate VII, fig. 1. Type example from the *Lower Green Sand* of Sandgate, figured by Sowerby in Trans. Geol. Soc.

„ fig. 2. A very fine specimen from a similar bed at Maidstone, in the Collection of Mr. Morris.

24. TEREBRATULA SELLA, Sowerby. Plate VII, figs. 4—10.

TEREBRATULA SELLA, Sowerby. Min. Con., vol. v, p. 53, pl. 437, fig. 1, 1825.

— — Fleming. A Hist. of British Animals, vol. i, p. 371, 1828.

— — Woodward. A Synoptical Table of Brit. Org. Remains, p. 21, 1830, (marked Up. Oolite by mistake.)

— BIPLICATA (part), V. Buch. Classification des Térébratules, Mém. Soc. Géol. de France, vol. iii, p. 218, 1834.

— SELLA, Brown. Illust. of Fossil Conch. of Great Britain, pl. lii, figs. 31, 32, 1838.

— — Ræmer. Kreid., p. 43, No. 41, 1840.

— BIPLICATA, Ræmer. Ib., pl. vii, fig. 17, 1840.

— SELLA, Leymerie. Mém. Soc. Géol. de France, vol. v, p. 30, 1842.

— — Morris. Catalogue, 1843.

— — Forbes. Quart. Journ. Geol. Soc., vol. i, p. 345, 1845.

— BIPLICATA, (part) Bronn. Index Pal., p. 1230, 1848.

TEREBRATULA SELLA, *D'Orbigny*. Pal. Franç., Terrains Crétacés, vol. iv, p. 91, pl. 510, figs. 6—12, and Prodrôme, vol. ii, p. 120, 1850.

— — Catalogue of the Terebratulæ in the British Museum, p. 28, 1853.

Diagnosis. Shell of a sub-quadrangular or somewhat pentagonal shape, rather longer than wide. Valves almost equally convex, slightly flattened; beak short, not much incurved, and obliquely truncated by a foramen of moderate dimensions, partly margined by a wide and short deltidium in two pieces. *Dorsal* or socket valve more or less prominently biplicated; the front is considerably elevated, narrow, regularly arched or bisinuated; lateral margins flexuous; surface smooth, with a few concentric lines of growth. Loop short, not exceeding a third of the length of the socket valve. Dimensions variable:

length 15,	width 14,	depth 8 lines.
„ 15,	„ 12,	„ 9 „

Obs. Sowerby observes that “when young, this shell is rather trigonal, in consequence of the length of the sides and roundness of the front; as it grows older, it becomes squarer, the front being more produced as well as more elevated; the beak is very slightly curved; the length and breadth are very nearly equal; the edges always sharp.” But we may add, that the separation of the plaits, as well as the depth of the sinus between them, is very variable according to specimens, and is even at times almost entirely filled up.

Several authors, among whom we may quote Baron V. Buch and Professor Bronn, have considered the species under description to be only a variety or synonym of *Ter. biplcata*, but M. D'Orbigny justly remarks, that although individuals of *Ter. sellæ* are at times found bearing some of the external aspect of *T. biplcata*, they are commonly well distinguished by their beak, foramen, deltidium, and position of the plaits, the last being much more elevated and closer in *T. sellæ*, producing a biplicated mesial fold, and a deep sinus in the ventral or dental valve. It cannot be confounded with *Ter. prælonga*, which is a much more elongated or scuttle-shaped shell.

In England, *Ter. sellæ* abounds in the *Lower Green Sand* of Atherfield (Isle of Wight), at Reigate, Pluckley, Ashford, Sandgate, and Hythe; it is likewise (but rarely) found in the *Gault* of Maidstone, whence an undeniable example was obtained by Mr. Bowerbank; and it is probable that some individuals continued to exist in the lower beds of the *Upper Green Sand*, an opinion arrived at from the inspection of a few uncertain examples found at Warminster and Farringdon.

On the Continent, M. D'Orbigny mentions having found it in the Terrain Néocomien Supérieur and Aptien of Combles, Gargas, Renaud-du-Mont, aux Salles, Castellane, Marolles, &c.

Plate VII, fig. 4. A remarkably adult and characteristic example, from the Lower Green Sand of the Isle of Wight; British Museum.

„ fig. 5. From a bed of the same age, at Pluckley; in the Collection of Mr. Harris.

Plate VII, fig. 6. From the Isle of Wight.

„ fig. 7. From Gault near Maidstone ; in Mr. Bowerbank's museum.

„ fig. 8. A specimen from the Isle of Wight, in the Geol. Society's Museum.

„ fig. 9. From the same locality, in the Collection of Mr. Morris.

„ fig. 10. A young shell ; Isle of Wight.

25. *TEREBRATULA TORNACENSIS*, Var. *RÆMERI*, *D'Archiac*. Plate VII, figs. 11—16, and Plate IX, figs. 1—8.

TEREBRATULA TORNACENSIS, *D'Archiac*. Mém. Soc. Géol. de France, vol. ii, 2d series, p. 318, pl. xviii, figs. 2—5, 1847.

— *RÆMERI*, *D'Archiac*. Ib., pl. xviii, fig. 6.

— *BOUEI*, *D'Archiac*. Ib., pl. xviii, fig. 7.

— *CRASSA*, *D'Archiac*. Ib., pl. xviii, fig. 8.

— *CRASSIFICATA*, *D'Archiac*. Ib., pl. xix, fig. 1.

— *RUSTICA*, *D'Archiac*. Ib., pl. xix, fig. 2.

— *BIPLICATA*, *D'Orbigny* ? (not *Brocchi* nor *Sowerby*), Pal. Franç., Terrains Crétacés, vol. iv, pl. 511, figs. 9—15, 1847.

— *RÆMERI*, *Sharpe*. Quart. Journ. Geol. Soc., vol. x, p. 191, 1853.

— *KEYSERLINGII*, *Sharpe*. Ib.

— *REVOLUTA*, *Sharpe*. Ib. ?

Diagnosis. Shell variable in shape, somewhat pentagonal ; as long as or longer than wide ; valves almost equally convex or flattened. *Dorsal* valve more or less distinctly biplicated towards the front. *Ventral* valve with a mesial plait corresponding with the sinus of the opposite one. Beak produced, slightly incurved and truncated by a rather large circular foramen, partly edged by a deltidium of moderate dimensions ; beak ridges tolerably defined, with a flattened space between them and the hinge line ; lateral margins somewhat flexuous and bisinuated in front. External surface smooth, at times obscurely longitudinally striated and marked by numerous concentric lines of growth ; shell structure largely punctated. Loop short and simple, not exceeding a third of the length of the smaller valve. Dimensions very variable :

length	10,	width	8½,	depth	5 lines.
„	9,	„	8,	„	4 „
„	8,	„	8,	„	3 „ &c.

Obs. The most common species in the Sponge Gravel or *Upper Green Sand* of Farringdon is that represented in Pl. VII, figs. 11—16, and Pl. IX, figs. 1—8, of the present Monograph ; it rarely exceeds 9 lines in length, with from 7 to 9 in breadth, is either elongated and moderately convex (Pl. VII, figs. 12, 13, 15, and Pl. IX, figs. 1, 2, 3, and 8), or as wide as long, and more or less compressed (Pl. VII, figs. 11, 13^a, 14, and Pl. IX, figs. 4 to 7). These shells present every kind of variation, but they are connected by insensible passages, and unquestionably, in my opinion, belong to the same species.

The next point (and one which has given me, perhaps, more trouble than almost any other in this work) was the endeavour to find out to what species these shells really belonged, and it was not until after two excursions to Farringdon, and the minute examination of more than three hundred examples, collected in the same spot by Messrs. Sharpe, Lowe, Forbes, Waterhouse, Morris, myself, and others, that I at last determined to consider the shells above described as a *small race* or variety of *Terebratula Tornacensis*, D'Archiac; and, indeed, several of the forms found in that locality are only *dwarf races*; thus, *Terebratella Menardi* and *T. depressa*, Lamarck, have not there attained the full size of those species found in the *Upper Green Sand* of Mans (France), or the *Tourtia* of Belgium; and it appears evident that local conditions during the formation of the Farringdon deposits were unfavourable to the full development of many of the forms of Brachiopoda, and which is no doubt the true cause of the stunted growth observable in many of the species.

The next point to investigate is whether *T. Tornacensis* is the oldest denomination the species has received? and I am still uncertain if *Ter. phasiolina*, Lamarck¹ (published in 1819, but without figure), may not be a young state of Vicomte d'Archiac's species; but as doubts at present involve that question, we will give preference to the Vicomte's claims,² and endeavour to discuss the value of some of its probable synonyms.

M. D'Orbigny considers the following names to be synonyms or varieties of *Terebratula biplicata* (Brocchi):—*Ter. Tornacensis*, *Bouei*, *crassa*, *Robertoni*, *crassificata*, *rustica*, *Boubei*, *Virleti*, *revoluta*, *sub-pectoralis*, *Keyserlingii*, and *Tchiatcheffii* (D'Archiac),³ but I differ from the author of the *Palæontologie Française*, (as elsewhere stated⁴) in the following particulars. I am of opinion that *Ter. biplicata* (Brocchi) is the same shell as that of Sowerby, which M. D'Orbigny considers distinct; the last-named author considers *Ter. Tornacensis* equivalent to *T. biplicata* (Brocchi), and of *T. biplicata*, Sow., forms a new species, to which he has applied the name *T. Dutempleana*. We, therefore, both so far agree in the opinion that *perhaps* there may exist two species, but disagree as to which Brocchi's figure should belong. I admit with M. D'Orbigny that *Ter. Ræmeri*, *Bouei*, *crassa*, *crassificata*, *rustica*, and perhaps *Ter. Murchisoni* and *Tchiatcheffii*, D'Archiac, may be only variations in age, &c., of *Ter. Tornacensis*; but I am not yet prepared to consider as such *Ter. Virleti* and *T. revoluta*, D'Archiac, and still less *Ter. Robertoni* and *T. sub-pectoralis* of the same author.

Mr. Sharpe and other palæontologists identify our Farringdon shell with *Ter. Ræmeri*; but after a lengthened examination, I was unable to find grounds of sufficient value for considering the last specifically different from *T. tornacensis*. It is true our British

¹ Animaux sans Vertèbres, vol. vi, No. 29, 1819.

² *Rapport sur les Fossiles du Tourtia*. Mém. Soc. Géol. de France, vol ii, 2d series, p. 316, &c., and plates xviii and xix, 1847.

³ *Prodrome*, vol. ii, p. 172, 1850.

⁴ See *Obs.* to our description of *Ter. biplicata*.

examples have not been hitherto obtained as large as the Belgian full-grown type, but this may be accounted for by the reasons already mentioned.

All our English examples of *T. biplicata* have the beak incurved, with the foramen close upon the umbo of the dorsal valve, so that the deltidium becomes inconspicuous and this seems likewise to have been the case with Brocchi's species, (if we are not misled by his figure),¹ while, on the contrary, in *T. tornacensis*, and in our Farringdon race, the deltidium is always more or less exposed, and the shell itself is also commonly wider in comparison to its length, than what we observe in the generality of our specimens of *T. biplicata*. Indeed, some of the Farringdon shells bear resemblance to some young examples of *Ter. maxillata*, Sow., so abundantly distributed in the Great Oolite of Hampton Cliff, near Bath. When quite young, *T. tornacensis* seems to be oval, with but a slight trace of biplication, in which condition it bears a great resemblance to many specimens of *T. biplicata* of a similar age. Viscount d'Archiac admits that his *Ter. Roemeri*, and *T. Bouei* may perhaps be only varieties of *T. tornacensis*; thus their close affinity had not escaped the scrutiny of that learned author.

The Sponge gravel of Farringdon is as yet our only British locality. On the Continent the species abounds in the *Tourtia* of Belgium, and in the *Upper Green Sand* of Mans, (France).

Plate VII, figs. 11 and 13. Wide examples from the *Upper Green Sand* of Farringdon, collection of Mr. Morris.

„ figs. 12 and 14. Other specimens, fig. 14 exhibiting a very thickened margin.

„ fig. 14^a. A malformation in the cabinet of Mr. Lowe, in which a very exceptional tendency to triplication may be observed. Malformations of this kind may likewise be seen, though very rarely in *T. biplicata* and *T. sella*, (Pl. VII, fig. 7.)

„ figs. 15 and 16. Elongated variety.

Plate IX, figs. 1 to 8. A series of specimens from the same locality, in the collection of Mr. Sharpe, figs. 4, 5, and 7, are referred by that author to *T. revoluta*, (d'Archiac), and fig. 8 to *T. Keyserlingii*, (d'Archiac),² fig. 3 bears also some resemblance to *Ter. Tchiatcheffii*.

¹ This observation had not escaped the notice of the celebrated author of the "*Progrès de la Géologie*," Mém. Soc. Géol. de France, vol. 2, 2d series, p. 317, 1847.

² These specimens were obligingly lent to me by Mr. Sharpe, with those names inscribed on his tablets.

26. *TEREBRATULA SULCIFERA*, (*Morris*). Plate VII, figs. 17—20.

TEREBRATULA SULCIFERA, *Morris and Dav.* Annals and Mag. of Nat. Hist., No. 133, vol. xx, p. 254, pl. xviii, fig. 7, 1847.

— — *D'Orbigny.* Prodrôme, vol. ii, p. 172, 1850.

— — A Catalogue of the Terebratulæ in the British Museum, p. 26, 1853.

Diagnosis. Shell obovate, oval or somewhat pentagonal and ventricose; valves almost equally convex; beak short, thick rounded, moderately incurved, and truncated by a large circular foramen; deltidium partly concealed beneath the anterior portion of the aperture, which overlies, and nearly touches the umbo of the *dorsal* or socket valve; margins very sinuous, externally ornamented by numerous concentric ridges of growth, regularly disposed from the beak and umbo to the margin; loop short and simple, not exceeding a third of the length of the socket or dorsal valve. Dimensions variable. Length 22, width 16, depth 16 lines.

Obs. This species varies greatly in external aspect; some examples (figs. 17 and 18) are much inflated, while others (fig. 19) are more or less compressed, and somewhat triangular in shape; at times, the frontal line is almost straight, but in the generality of specimens this portion of the ventral valve indents the opposite one; the sulci are likewise more or less produced, and regular. It is readily distinguished from *Ter. semiglobosa*, by the large dimensions of its foramen, and from *T. obesa*, by its sulci, which are shorter and more inflated in appearance.

Ter. sulcifera occurs in the Lower Chalk of Cherry Hinton and Isleham, near Cambridge; at Hockwold, Norfolk, and in other localities.

Plate VII, fig. 17. A very large, and fine example, discovered by Mr. Bunbury, figured in the 'Annals and Mag. of Nat. Hist.,' as the type of the species.

„ figs. 18, 19, and 20. Other specimens from the Lower Chalk of the neighbourhood of Cambridge, in the collection of Mr. Morris.

27. *TEREBRATULA SEMIGLOBOSA*, *Sowerby*. Plate VIII, figs 6—18.

TEREBRATULA SEMIGLOBOSA, *Sowerby.* Min. Con., vol. i. p. 48, tab. xv, fig. 9, 1813.

— SUBUNDATA, *Sowerby.* Ib., p. 47, pl. xv, fig. 7, 1813.

— SUBROTUNDA (part) *Sow.* Ib., tab. xv, figs. 1-2, 1813.

— SUBUNDATA, *W. Smith.* Strata identified by organised fossils, p. 10, Pl. iv, fig. 8, 1816.

— — *Lamarck.* An. sans Vert., vol. vi, p. 248, No. 13, 1819.

— SEMIGLOBOSA, *Lamarck.* Ib., p. 251, No. 27.

— — and T. SUBUNDATA, *Parkinson.* Trans. Geol. Soc., vol. v, 1821.

— — *Mantell.* Geol. of Sussex, p. 209, 1822.

— — *Brong.* Env. de Paris, pl. ix, fig. 1, 1822.

— — *Fleming.* A Hist. of British Animals, vol. i. p. 369, 1828.

- TEREBRATULA SEMIGLOBOSA, *Schlotheim*. System Vers., No. 80, 1832.
- — *V. Buch*. Classification des Terebratules Mém. Soc. Géol. de France, vol. iii, p. 205, pl. xix, fig. 9, 1834.
- SUBUNDATA, *Deshayes*. Nouv. Ed. de Lamarck, vol. vii, p. 333, No. 13, 1836.
- SEMIGLOBOSA, *Hisinger*. Leth. Suec., p. 82, pl. xxiv, fig. 2.
- — *Bronn*. Leth Geog., pl. xxx, fig. 11, p. 657, 1837, and Index Pal., p. 1250, 1848.
- — *D'Orbigny*. Pal. Franç., Terrains Crétacés, vol. iv, p. 105, pl. 514, fig. 1—4, 1837, and Prodrôme, vol. ii, p. 258.
- — *Brown*. Illustrations of Fossil Conch., pl. liv, fig. 45-46, 1838.
- — *Geinitz*. Char. Kreid., p. 16, 1839.
- — *Rœmer*. Die Vers. Nord. Kreid., p. 43, No. 42, 1840.
- ALBENSIS, *Leymerie*. Mém. Soc. Géol. de France, vol. iv, pp. 288, 289, 1841; ii, p. 29, tab. xv, figs. 2—4, 1842.
- SEMIGLOBOSA, *Leymerie*. Mém. Soc. Géol. de France, vol. v, 1842.
- — T. SUBROTUNDA, and T. SUBUNDATA, *Morris*. Catalogue, 1843.
- — *Reuss*. Bohem. Kreid., pl. xxvi, figs. 5—8, 1846.
- CARNEA, *Reuss*. Ib., pl. xxvi, figs. 9—11.
- BULLA, *J. de Sow*. in *Dixon*. Geol. and Fossils of the Tertiary and Cretaceous Formations of Sussex, p. 346, tab. xxvii, p. 11, 1850.
- SEMIGLOBOSA and T. ALBENSIS. A Catalogue of the Fossil Terebratulæ in the British Museum, p. 25, 1853.

Diagnosis. Shell variable in shape, inflated, circular, or elongated oval; *ventral* or dental valve, commonly the deepest, and uniformly gibbous; beak short, more or less incurved, and perforated by a small circular foramen, contiguous to the umbone of the opposite valve; deltidium in two pieces, commonly inconspicuous; beak ridges undefined; margins flexuous, straight, or bisinuated in front; the *dorsal* valve is uniformly convex or biplicated towards the frontal margin. External surface smooth, marked by concentric lines of growth; shell structure minutely punctate; loop short and simple, not exceeding a third of the length of the dorsal valve.

Dimensions very variable: length 21, width 18, depth 15 lines;

„	11,	„	11,	„	9	„
„	13,	„	11,	„	7	„
„	16,	„	11,	„	11	„ &c.

Obs. In the first volume of the 'Mineral Conchology,' the names *Ter. subundata* and *T. semiglobosa*, were proposed for varieties of a single form; but most authors have preferred the last denomination on account of its having been applied to the adult and common condition in which the species is obtained. *T. subundata* is only a less convex or more depressed variety, and it appears likewise, probable, that *T. subrotunda* of the same author, may have been founded (at least in part) on a variety of *T. semiglobosa*; but

Sowerby is certainly in error while supposing that the same shell was common to the Chalk and Cornbrash. Baron V. Buch, and others, have likewise erroneously added to their synonyms of *T. semiglobosa*, the *T. intermedia* (Sow.), a Jurassic species, distinguished by shape and character.

Sowerby mentions that, in the true type of *T. semiglobosa*, the frontal margin is slightly “*undulated with two risings*” or plaits; but after inspecting a series of several hundred specimens from the Lower Chalk of Lewes, Chardstock, and other localities, it appeared evident that the front was at times almost straight or arched, without any defined biplication, and it was from shells presenting this last condition, that Mr. Leymerie founded his *T. albensis*.¹ *T. semiglobosa* is also distinguished from *T. carnea* (Sow.), this last being a much more depressed shell, with a uniform straight margin, a character observable only in young examples of the species under consideration. And it may be worthy of notice, that we rarely find both forms associated in the same bed or locality; where the one abounds the other seems wanting: thus, in the Upper Chalk of Norwich, Brighton, Meudon, &c., where *T. carnea* is common, *T. semiglobosa* is absent; while the inverse takes place in the Lower Chalk of Lewes, Gravesend, Chardstock, &c.

Ter. bulla, Sow., figured in pl. xxxii, of Dixon’s work, is also only an unusually large and more elongated form of *T. semiglobosa*, possessing no other valid distinguishing feature.

The vertical range of this species appears to be greater than that of *Ter. carnea*; we first find it in the *Red Chalk* of Hunstanton, believed by some geologists to represent the age of the Gault: it abounds in the *Chalk Marl* and *Lower Chalk* of Lewes, Charing, Gravesend, Tytherleigh, Chardstock, and other localities. On the Continent, it is very common near Rouen, in the Dep. de l’Aube, &c.

Plate VIII, fig. 6. *Ter. semiglobosa*, from the Lower Chalk of the neighbourhood of Lewes (Sussex).

- | | | | |
|---|----------|---|---|
| „ | fig. 7. | „ | from Gravesend. |
| „ | fig. 8. | „ | a remarkable variety, from Lewisham (Kent). |
| „ | fig. 9. | „ | Sowerby’s original figure of <i>T. subrotunda</i> ; specimens very similar to this may be collected near Lewes. |
| „ | fig. 10. | „ | A large example from Lewes, in the collection of Mr. Catt. |
| „ | fig. 11. | „ | another specimen (<i>T. bulla</i> , Sow.), in the collection of Mr. Wetherell. |
| „ | fig. 12. | „ | a specimen from the Chalk of Grays, in the cabinet of Mr. Morris. |

¹ *Ter. albensis* is supposed by Prof. Bronn and M. D’Orbigny to be a variety of *T. obesa*, but the proportions of the foramen in the two forms is so different, as hardly to warrant such a conclusion.

Plate VIII, fig. 13. *Ter. semiglobosa*, from the Lower Chalk of Charing (Kent), in the collection of Mr. Harris.

- „ fig. 14. „ a very elongated specimen, probably a malformation, from the Chalk of Gravesend, in the collection of Mr. Bowerbank.
- „ fig. 15. „ a specimen from Glyndebourn, near Lewes, (*T. albensis*, Leymerie).
- „ fig. 16. „ from the Lower Chalk of Charing, in the collection of Mr. Harris.
- „ fig. 17. „ from the Red Chalk of Hunstanton (*T. subundata*, Sow.), collection of Mr. Morris.
- „ fig. 18. „ a specimen from the Chalk, with quartz grains, Evershot (Dorsetshire), in the collection of Mr. Morris.

28. *TEREBRATULA CARNEA*, *Sowerby*. Plate VIII, figs. 1—4.

- TEREBRATULA CARNEA*, *Sowerby*. Min. Con., vol. i, p. 47, tab. xv, figs. 5, 6, 1812.
- — *Lamarck*. An. sans Vert., vol. vi, p. 248, No. 14, 1819.
- — *Brongniart*. Desc. Géol. des Environs de Paris, pl. iv, fig. 7, 1822.
- — *Parkinson*. An Introd. to the Study of Organic Remains, p. 234, 1822.
- *ELONGATA*, *Sow*. Min. Con., vol. v, p. 49, tab. 435, figs. 1 & 2, 1825.
- *OVATA*, *Nilsson*. Petref. Suec., p. 34, pl. iv, fig. 3, 1827 (not *T. ovata*, Sow.).
- *LENS*, ? *Nilsson*. Ib., p. 35, pl. iv, fig. 6.
- *CARNEA*, *DeFrance*. Dic. d'Hist. Nat., vol. 53, 1828.
- — *Fleming*. A Hist. of British Animals, p. 369, 1828.
- — *Deshayes*. Encycl. Method., iii, p. 1028, No. 20, 1828.
- — and *T. ELONGATA*, *Woodward*. A Synoptical Table of Organic Remains, p. 21, 1830.
- — *Schlotheim*. Syst. Vers., No. 64, 1832.
- — *Mantell*. Geol. of the South-east of England, p. 127, 1833.
- — *Von Buch*. Classification et Descriptions des Terebratules, Mém. Soc. Géol. de France, vol. iii, p. 203, pl. xix, fig. 2, 1834.
- — *Bronn*. Leth. Geog., pl. xxx, fig. 13, p. 654, 1837.
- — *Pusch*. Polens Pal., p. 18, t. iii, fig. 12, 1837.
- *SUBROTUNDA*, *D'Orbigny*. Pal. Franç., Ter. Crétacés, vol. iv, 1837 (not *Sowerby*).
- *OVATA*, *Hisinger*. Leth. Suec., p. 82, pl. xxiv, fig. 3, 1837 (not *T. ovata*, Sow.).
- *CARNEA*, *Brown*. Illustrations of Fossil Conch. of Great Britain, pl. liv, figs. 30—33, 1838.

- TEREBRATULA CARNEA, *Geinitz*. Char. Kreid., p. 16, 1839.
 — — *Ræmer*. Die Vers. Nord. Kreid., 1840 (but not all his
 Synonymes).
 — OVATA, *Ræmer*. Ib. (but not *T. ovata*, Sow.).
 — CARNEA, *Morris*. Catalogue, 1843.
 — — *D'Orbigny*. Russia and Oural, vol. ii, p. 494, pl. xliii, figs. 21
 —25, 1845.
 — — *Reuss*. Bohem. Kreid., p. 50, No. 14, tab. xxvi, figs. 10, 11,
 1846 (but not all his Synonymes).
 — — *D'Orbigny*. Pal. Franç., Ter. Crétacés, vol. iv, p. 103, pl. 515,
 figs. 5—8, 1847, and Prodrôme, vol. ii, p. 258.
 — — *Bronn* (part). Index Pal., vol. ii, p. 1232, 1848 (but not all
 his Synonymes).
 — — *Alth.* Geol. Lemberg (in Haidinger's Abhandl.), p. 258,
 tab. xiii, fig. 8, 1850.
 — — *Quenstedt*. Handb. de Petref., p. 473, tab. xxxviii, figs. 3, 4,
 1851.
 — — A Catalogue of the Terebratulæ in the British Museum, p. 21,
 1853.

Diagnosis. Shell ovate, circular, elongated oval, or obtusely five sided, with somewhat depressed and almost equally convex valves; beak short, more or less incurved, and perforated by a small circular foramen, partly surrounded, and separated from the hinge line by a wide concave triangular deltidium, transversely wrinkled; margin nearly straight all round. Surface smooth, marked only by a few concentric lines of growth. Shell structure minutely punctated. Colour of a light or dull red. In the interior of the smaller or dorsal valve, the cardinal process is more or less produced; the loop short and simple, rarely exceeding a fourth of the length of the socket valve.

Dimensions very variable: length 17, width $15\frac{1}{2}$, depth 10 lines;

„ 17, „ 12 „ 9 „
 „ 20, „ 19 „ 11 „ &c.

Obs. This well-known shell was first described and figured by Sowerby, under the name of *T. carnea*, on account of the fleshy red tinge presented by many specimens; and which is no doubt remains of the original colour, which was in all probability similar to that still observable in several recent Terebratulæ, such as *T. lenticularis* so abundantly found in the deep sea of Fauveau Straits, New Zealand. *T. carnea* varies more or less in external shape; to the lengthened example, Sowerby applied the name *T. elongata*.

Several Palæontologists, among whom we may mention M. D'Orbigny, have placed the so-termed *T. subrotunda* of Sowerby ('Min. Con.,' tab. xv, figs. 1 and 2), among the synonymes of *T. carnea*, but it is doubtful whether this determination be correct; the figure in the 'Min. Con.' represents a circular Terebratula bearing external resemblance to some varieties of *T. carnea*, but, as the locality and bed mentioned is "*the hardest chalk about Hornisham, in Wiltshire,*" it seems probable that the illustration was not taken

from a specimen of *T. carnea*, but from a flattened variety of *T. semiglobosa*; and the author has rendered his species the more problematical, by adding, that his friend Mr. Meade had sent him specimens *from the Cornbrash*, $1\frac{1}{4}$ inch in length! Dr. Mantell refers to *T. subrotunda*, Sow., a shell from Hamsey and Eastbourn (Sussex),¹ but Messrs. Waterhouse and Woodward, who have seen the original, have pronounced it to be simply a depressed young individual of *T. subundata* or *T. semiglobosa*, and agreeing with Sowerby's type. I may add, that I likewise possess specimens of *T. semiglobosa*, from Glyndebourn, near Lewes, quite as circular and depressed as the figure of *T. subrotunda* in the 'Min. Con.'

Some authors² have likewise erroneously described *T. ovata* (Sow.) as a synonyme of *T. carnea*, a mistake principally referable to Dr. Mantell,³ who does not appear to have been acquainted with Sowerby's type, which was stated to occur at Chute, near Heytesbury, in Wiltshire, an Upper Green Sand locality, where no true specimen of *T. carnea* has been discovered.

The great resemblance *T. carnea* bears to some examples of the recent *T. vitrea*, did not escape the observation of the late Baron Von Buch;⁴ but I am disposed to coincide with M. D'Orbigny, in the belief, that they are specifically distinct. *T. vitrea* never presents the colour with which we believe *T. carnea* was tinted.

The foramen in some examples is so small as hardly to afford space for the passage of a hair; but in the generality of individuals the aperture, although always small, is far from presenting such minute proportions.

In the neighbourhood of Norwich, a great number of internal siliceous or flint casts of this species have been collected by Mr. Fitch, on which the muscular and other impressions are beautifully represented.

Sowerby mentions that he found *Ter. carnea* in the soft Chalk of Towse, near Norwich, and from that locality many beautiful examples have been procured by Messrs. Fitch, Woodward, Image, and others; it likewise occurs at Trimmingham, Brighton, in Ireland, and in many other Chalk localities. On the Continent, it is very common in similar deposits at Meudon, near Paris; Halden, Westphalia, in Russia, &c.; but seems to be very rare in Lower Chalk beds and localities characterised by *T. semiglobosa*.

Plate VIII, fig. 1. A typical specimen of *T. carnea* from the Chalk of Trimmingham.

„ fig. 2. Interior of the larger or ventral valve.

„ fig. 2^a. Interior of the smaller or dorsal valve, with the loop.

¹ Geol. of Sussex, p. 130.

² Among these, we may mention M. D'Orbigny (see 'Pal. Franç., Terrains Crétacés,' vol. iv, p. 103, 1847).—Dr. Bronn ('Index Pal.,' vol. ii, p. 1232).—See also Nilsson and Hisinger.

³ Geology of Sussex, 1822.

⁴ Mémoires de la Soc. Géol. de France, vol. iii, p. 204.

Plate VIII, fig. 3. A lengthened variety, *T. elongata*, Sow., from the Chalk of Norwich, in the cabinet of Mr. Fitch.

„ fig. 4. A large circular variety from the same locality, in the collection of the Rev. T. Image.

„ fig. 5. Another example from the same locality.

29. *TEREBRATULA DEPRESSA*, *Lamarck*. Plate IX, figs. 9—24.

TEREBRATULA DEPRESSA, *Lamarck*. Hist. des An. sans Vert., vol. vi, p. 249, 1819,¹
and *Dar. Notes on an examination of Lamarck's species of*
Fossil Terebratula, Annals and Mag. of Nat. Hist., vol. v,
2d ser., pl. xiii, fig. 15, 1850.

— *OVALIS*, *Morris*. Quart. Journal Geol. Soc., Nov., 1846 (not *T. ovalis*,
Lamarck).

— *NERVIENSIS*, *D'Archiac*. Mém. Soc. Géol. de France, vol. ii, 2d ser.,
p. 313, pl. xvii, figs. 2—10, 1847.

— *VIQUESNELI*, *D'Archiac*. Ib., p. 316, pl. xviii, fig. 1.

— *DEPRESSA*, *Bronn*. (part). Index Pal., vol. ii, p. 1234, 1848.

— — *D'Orbigny*. Prodrome, vol. ii, p. 172, 1850.

— — *Sharpe*. Quart. Journ. of the Geol. Soc., vol. x, p. 191, 1853.

Diagnosis. Shell depressed, oblong oval, tapering at the beak; valves almost equally deep, externally smooth, and marked by a few concentric lines of growth. *Dorsal* or socket valve either regularly convex or interrupted by a mesial fold of moderate elevation; *ventral* valve with, or without, a shallow longitudinal depression; beak nearly straight, more or less produced, and truncated by a large circular foramen, partly margined by a wide deltidium, in one piece; beak ridges undefined, lateral margins moderately flexuous, frontal edge of the ventral valve indenting to a greater or lesser extent than that of the dorsal one. Loop short and simple, not exceeding a third of the length of the smaller or dorsal valve.

Dimensions variable: length 22, width 17, depth 14 lines;

„ 20, „ 20, „ 11 „

Obs. This *Terebratula* is one of our largest Cretaceous forms, varying very considerably in shape and comparative dimensions. When quite young it is much depressed, with the margins straight all round; but with age, the valves either continue to remain regularly convex without any defined mesial fold, or with one of moderate elevation. The beak is also more or less produced, and at times much elongated, with a large deltidium bearing resemblance to that peculiar to *Ter. longirostris* of Wahlenberg; but the Lamarckian species seems separable by its greater width, and by the almost total absence

¹ “*T. testa oblonga transversim dilatata, supra coarctata et obtusa, striis concentricis laevibus; nate producta non incurva: foramine magno.*”

of the longitudinal depression or biplication so strongly marked in adult examples of the Swedish type.

In Belgium, *T. depressa* is perfectly characterised, and abounds in the *Tourtia* of Tournay, Montignies-sur-Roc, and Gussignies, whence Lamarck obtained his specimens;¹ but in England, we are at present only acquainted with the single locality of Farringdon, where the race does not seem to have attained the large dimensions of the Belgian type. Our British examples are commonly shorter, and more stunted in their growth, and the mesial fold is at times more produced than in the generality of Belgian individuals.

T. depressa does not seem to have been yet discovered in France, no mention of it being made in the 'Palæontologie Française.'

In 1847, Viscount d'Archiac believed the species new, and named it *Terebratula nerviensis*.² In 1846, the same shell was mistaken by Mr. Morris, for *T. ovalis* (Lamarck), which last belongs to the Jurassic epoch, and is specifically distinct.³ And in 1848 Professor Bronn considered *T. longirostris* to be a synonym of the Lamarckian *T. depressa*; an opinion in which I am unable to concur.

Many varieties might be noticed, but from these passing one into the other they do not in my opinion require distinguishing denominations. *Ter. Viquesneli*, D'Archiac, is one of them, it is found likewise at Farringdon, but appears to be simply a young state of the Lamarckian species.

Plate IX, fig. 9. One of the largest examples hitherto discovered in the Upper Green Sand of Farringdon. The valves are commonly found detached.

„ fig. 10. A ventral valve, from the collection of Mr. Sharpe.

„ fig. 11. A specimen drawn from two separate valves, in the collection of Mr. Sharpe.

„ figs. 12—21. Different examples, ages, and varieties, of *T. depressa*; figs. 14 and 17 from the collection of Mr. Lowe; figs. 18 to 21, from that of Mr. Sharpe.

„ figs. 22—23. A young specimen of *T. Viquesneli*, D'Archiac, from Farringdon, in the collection of Mr. Sharpe.

„ fig. 24. A copy of the Belgian figure of *T. Viquesneli*, published by Viscount d'Archiac, for the sake of comparison.

¹ The original specimens are now in Baron Delessert's collection, and were figured by myself in the 'Annals' for 1850.

² This species was admirably described and figured by the distinguished French author in his "*Rapport sur les Fossiles du Tourtia*," 'Geol. Trans. France,' 1847.

³ *Ter. Repeliniana*, D'Orb. ('Prodrôme,' vol. ii, p. 25, 1850), from the White Coral Rag, near Vurey (Isère), &c., bears more resemblance to *Ter. depressa* (Lamarck), than any other *Terebratula* with which I am acquainted.

30. *TEREBRATULA CARTERI*, *Dav.* Pl. VII, fig. 3.

Diagnosis. Shell elongated oval, or unequally five sided, and somewhat compressed; *ventral* valve deeper than the dorsal one, with a shallow longitudinal sinus corresponding with a mesial fold of moderate elevation; beak short, slightly incurved, and truncated by a foramen of moderate dimensions; deltidium almost inconspicuous. Surface smooth, marked by a few concentric lines of growth. Lateral margins slightly flexuous, with the ventral frontal edge indenting that of the dorsal valve. Loop unknown, but in all probability short and simple. Length 20, width 15, depth 10 lines.

Obs. I obtained this shell some years ago from the Gray Chalk, near Dover, and have been unable to identify it with any of the other British Cretaceous forms that have come under my observation, it bears much of the outward aspect of some Jurassic *Terebratulæ*, although perfectly identical with none of those with which I have compared it. I therefore take great pleasure in naming it after Mr. Carter, who has afforded such valuable assistance in the working out of the Cambridge *Upper Green Sand* species.

Plate VII, fig. 3. *Ter. Carteri*, from the Gray Chalk in the vicinity of Dover.

31. *TEREBRATULA ROBERTONI*, *D'Archiac.* Plate IX, fig. 25.

TEREBRATULA ROBERTONI, *D'Archiac*, Mém. Soc. Géol. de France, vol. ii, 2d series, p. 315, pl. xviii, fig. 2, 1847.

— — *Sharpe*, Quart. Journ. of the Geol. Soc., vol. x, p. 192, 1853.

Diagnosis. Shell of an elongated oval shape; valves regularly convex, the ventral one rather the deepest; surface smooth, marked by concentric lines of growth; beak moderately produced, incurved and truncated by a large circular foramen, partly margined by a short deltidium; *ventral* valve somewhat keeled; beak ridges undefined, lateral margins flexuous, the frontal edge of the ventral valve slightly indenting the opposite one. Loop unknown, probably short and simple. Length 11, width 8, depth $5\frac{1}{2}$ lines.

Obs. Viscount D'Archiac states¹ that *Ter. Robertoni* differs from *T. depressa*, Lamarck (his *T. nerviensis*), by its more regularly rhomboidal form, unequal depth of the valves, almost entire absence of sinuosity in front, and above all by the inflated extremity of its prominent and incurved beak. M. D'Orbigny appears to consider *T. Robertoni* as a simple synonyme of *T. buplicata*;² but this appears far from being the case, since it does not present any trace of biplication, a character always more or less visible in Brocchi's species, and it differs likewise in external shape. *T. Robertoni* was found in the Sponge Gravel of the Upper Green Sand of Farringdon, by Mr. Lowe, it agrees exactly both in

¹ 'Rapport sur les Fossiles du Tourtia, p. 315.

² 'Prodrome,' vol. ii, p. 172.

shape and dimensions, with the type figured by Viscount D'Archiac, from the Tourtia near Tournay (Belgium). The same French author states to have likewise collected the species in a bed of *Upper Green Sand*, above the *Gault*, near Wissant (Pas-de-Calais), France.

Plate IX, fig. 25. *Ter. Robertoni*, from Farringdon, in the collection of Mr. Lowe.

32. WALDHEIMEA (TEREBRATULA) CELTICA, *Morris*. Plate IX, figs. 32—35.

TEREBRATULA LONGA, *Rømer*. *Verst. Nordd. Ool.*, p. 50, pl. ii, fig. 11, 1836; *Kreid.*, p. 44, No. 50, 1840. (Not *T. longa*, Zieten, 1832.)

— — *Morris*. *Annals Nat. Hist.*, vol. xx, p. 255, pl. xix, fig. 1, 1847.

— *FABA, D'Orbigny*. *Pal. Franç.*, *Ter. Crétacés*, vol. iv, p. 77, pl. xiv, figs. 10. (Not *T. faba*, Sow., *Trans. Geol. Soc.*, vol. iv, p. 14, fig. 10, 1836.)

WALDHEIMEA CELTICA, *Morris*. *MS. Catalogue of the Terebratulæ in the British Museum*, p. 62, 1853.

Diagnosis. Shell oblong, elongated oval, ventricose posteriorly, becoming rather attenuated anteriorly, and subtruncate; valves nearly equally convex, ventral valve somewhat keeled; beak slightly produced, and obliquely truncated by a foramen of moderate dimensions, partly surrounded and separated from the hinge line by a small deltidium in two pieces; beak ridges more or less defined; *dorsal valve* most inflated near the umbo; margins even; surface smooth, marked only by a few concentric lines of growth. Loop elongated, reaching to near the frontal margin before becoming reflected. Shell structure punctated. Length 17, breadth 10, depth 8 lines.

Obs. This form was described and figured by Rømer, in 1836, under the name of *T. longa*;¹ but Zieten had already made use of the same denomination to designate a Jurassic Terebratula from Donsdorf.²

In 1847, the species under notice, was discovered by Dr. Fitton and Mr. Morris, in hard ferruginous nodules of the Lower Green Sand at Horseledge and Yellowledge, near Shanklin Bay (Isle of Wight), and published under Rømer's denomination; but Mr. Morris having subsequently found that the shell differed specifically from the Jurassic type, has proposed for it the name of *Ter. Celtica*.

M. D'Orbigny commits another mistake, while considering *T. longa* (Rømer) the same as *T. faba* of Sowerby; but the author of the '*Palæontologie Française*' was not probably aware that the so-termed *T. faba* (Sow.) is itself only a variety or dwarf example of the well-known *T. biplicata* (Brocchi), from the Upper Green Sand of

¹ Rømer appears to have figured and described in his '*Die Verst. der Nord. Oolithen Gebirges*,' 1836, a series of Fossils belonging to the Hils Conglomerate, but which he considered at that epoch, as Jurassic, among these, we find his *T. longa*. The author has subsequently corrected this mistake in his monograph of the Chalk of that country.

² '*Die Verst. Wurtembergs*, pl. xxxix, fig. 7.

Warminster, and therefore not only specifically and stratigraphically distinct from Roemer's *T. longa*, but belonging to a different section of the great genus *Terebratula*.

T. Celtica appears easily to be distinguished from other Cretaceous species by its peculiar elongated shape.

Roemer's specimens are said to be from the Hilsthorn of Elligser Brinkes.

Plate IX, figs. 32—34. Examples from the Lower Green Sand, near Shanklin Bay, Isle of Wight, in the collection of Mr. Morris; several fine specimens have also been collected in the same locality by Mr. S. Saxby, of Bonchurch.

33 WALDHEIMEA (TEREBRATULA) TAMARINDUS, *Sowerby*. Plate IX, figs. 26—31.

TEREBRATULA TAMARINDUS, *Sowerby*. Trans. of the Geol. Soc., vol. iv, p. 338. pl. xiv, fig. 8, 1836.

— — — *Morris*. Catalogue, 1843.

— SUBTRILOBATA, *Leymerie*. Mém. Soc. Géol. de France, vol. v, p. 12, pl. xv, figs. 7, 9.

— TAMARINDUS, *Bronn*. Index Pal., p. 1253, 1848.

— — — *D'Orbigny*. Pal. Franç., Terrains Crétacés, vol. iv, p. 72, pl. 505, figs. 1—10, 1847: Prodrôme, vol. ii, p. 85, 1850.

WALDHEIMEA TAMARINDUS. A Catalogue of the Fossil Terebratulæ in the British Museum, p. 62, 1853.

TEREBRATULA TAMARINDUS, *Sharpe*. Quart. Journ. Geol. Soc., vol. x, p. 191, 1853.

Diagnosis. Shell very variable in shape, nearly orbicular, oval or obtusely five-sided; surface smooth, marked by a few concentric lines of growth. Valves almost equally convex, without either sinus or mesial fold; the *ventral* or perforated valve is generally the deepest; margin very obtuse and slightly flexuous, forming a small convex curve in front; beak moderately incurved, and truncated by a circular foramen, partly surrounded, and slightly separated from the hinge line by a deltidium in two pieces; beak ridges incurved, so as to approach the hinge margin. Loop elongated, reaching to near the frontal margin before becoming reflected. Shell structure largely punctated. Length 7, width 6, depth 4 lines.

Obs. The dimensions of *Ter. tamarindus* do not appear to have ever greatly exceeded seven lines in length. It occurs in the *Lower Green Sand* of the Isle of Wight; *Kentish Rag*, near Sandgate, and in the *Upper Green Sand* of Farringdon. On the Continent, it is mentioned, as occurring in the *Lower Nécomien* of Auxerre (Yonne), Bettancourt-la-Ferrée, at Wassy, Saint-Dizier, &c. It was also discovered by M. De Verneuil, in Spain. The margin is often considerably thickened. It is a rare British Cretaceous Fossil.

Plate IX, fig. 26. A specimen from the Kentish Rag, near Sandgate.

Plate IX, figs. 27 and 28. Two examples from the *Upper Green Sand* of Farringdon, in the collection of Mr. Sharpe; this shell is one of the rarest in the locality.

„ figs. 29 and 30. Two specimens from the *Lower Green Sand* of the Isle of Wight, from the collection of Mr. Morris.

„ fig. 31. A pentagonal specimen, with a very thickened edge, Isle of Wight.

Genus—RHYNCHONELLA, *Fischer*, 1809.

Obs. This genus having been described in p. 93 of the “Introduction,” and in Part III, p. 65, it will not be necessary to repeat those details in the present Monograph.

The most active researches among the British Cretaceous *Rhynchonellæ* have not brought to light a single unpublished species, and so numerous are the varieties and passages from one form into another, that it is often almost impossible to draw up a diagnosis embodying the character of every variety. We have admitted the following fourteen species, as well as some few named varieties:—

{	1.	RHYNCHONELLA PLICATILIS, <i>Sow.</i>	{	9.	RHYNCHONELLA SULCATA, <i>Parkinson.</i>
	—	<i>var. OCTOPLICATA, Sow.</i>		10.	— MANTELLIANA, <i>Sow.</i>
{	—	<i>var. WOODWARDII, Dav.</i>		11.	— CUVIERI, <i>D'Orb.</i>
	2.?	— LIMBATA, <i>Schloth.</i>		12.	— MARTINI, <i>Mantell.</i>
{	3.	— COMPRESSA, <i>Lam.</i>		13.	— GRASIANA, <i>D'Orb.</i>
	4.	— LATISSIMA (LATA), <i>Sow.</i>		14.	— LINEATA, <i>Phillips.</i>
{	5.	— GIBBSIANA, <i>Sow.</i>			
	6.	— PARVIROSTRIS, <i>Sow.</i>			
{	7.	— DEPRESSA, <i>Sow.</i>			
		<i>var. A.</i>			
{		<i>var. B.</i>			
	8.	— NUCIFORMIS, <i>Sow.</i>			

Some Palæontologists may, perhaps, consider *R. limbata*, Schl. (= *sub-plicata*, of Mantell) as only a variety of *R. plicatilis*, and it may be still a question whether *R. Grasiiana* is more than the adult condition of *R. Martini*, Mantell. Mr. S. P. Woodward considers *R. octoplicata* as specifically distinct from *R. plicatilis*, and Mr. Sharpe admits *R. triangularis*, Wahl., among our British species.

34. RHYNCHONELLA PLICATILIS, *Sow.*, Sp. Plate X, figs. 37—42.

var. OCTOPLICATA, Sow. Plate X, fig. 1—17.

var. WOODWARDII, Dav. Plate X, figs. 43—46.

TEREBRATULA PLICATILIS, *Sowerby.* Min. Con., vol. ii, tab. 118, fig. 1, 1816.

— OCTOPLICATA, *Sowerby.* Ib., fig. 2, 1816.

- TEREBRATULA PLICATILIS, *Mantell*. Fossils of the South Downs, p. 210, 1822.
- OCTOPLICATA, *Brongniart*. Desc. Géol. des Environs de Paris, pl. 4, fig. 8, 1822.
- — and PLICATILIS, *Parkinson*. An Introduction to the Study of Organic Remains, p. 234, 1822.
- — *Dalman*. Vet. Acad. Handl., p. 53, 1827.
- PLICATILIS, *Defrance*. Dic. Sc. Nat., vol. liii, p. 159, 1828.
- OCTOPLICATA, *Fleming*. A Hist. of British Animals, vol. i, p. 372, 1828.
- PLICATILIS and T. OCTOPLICATA, *Woodward*. A Syn. Table of Org. Remains, pp. 21 and 22, 1830.
- — *Deshayes*. Coq. Caractéristiques, p. 114, pl. ix, figs. 3, 4, 1831.
- — *Deshayes*. Ency. Meth., iii, p. 1026, No. 11, 1832.
- OCTOPLICATA and T. PLICATILIS, *Schlotheim*. Syst. Vers. Petref., 1832.
- — — *Mantell*. Geol. of the S. E. of England, p. 127, 1833.
- — *V. Buch*. Class. des Térébratules, 1834; and Mém. Soc. Géol. France, vol. iii, p. 147, pl. xv, figs. 18—24.
- PLICATILIS, *V. Buch*. (part). Ib., 1834; and ib., vol. iii, p. 153, tab. xv, fig. 24, 1838.
- — and T. OCTOPLICATA, *Deshayes*. Nouv. Ed. de Lamarck, vol. vii, p. 356—7, 1836.
- OCTOPLICATA, *Hisinger*. Leth. Suec., p. 79, pl. xxii, fig. 12, 1837.
- — *D'Archiac*. Mém. Soc. Géol. de France, vol. iii, p. 295, 1839.
- PLICATILIS, *Geinitz*. Charact. Petref. Kreid., p. 14, 1839.
- OCTOPLICATA, *Bronn*. Leth. Geog., pl. xxx, fig. 9, 1837.
- PLICATILIS and T. OCTOPLICATA, *Rœmer*. Die Vers. Nord. Kreid., p. 38, fig. 9, 1840.†
- OCTOPLICATA, *Geinitz*. Charat. Kreid., pl. xvi, fig. 16, 1840.
- PLICATILIS and T. OCTOPLICATA, *De Hagenow*. N. Jahrb. F. Mineral., 1842.
- — *Morris*. Catalogue, 1843.
- — *Geinitz*. Grundriss. die Vers., pl. xxi, fig. 3, 1844.
- — and T. OCTOPLICATA, *Reuss*. Bohem. Kreid., p. xxv, figs. 10—16, 1846.
- OCTOPLICATA, *D'Orbigny*. Russia and the Oural, vol. ii, p. 492, pl. xliii, figs. 15—17, 1845.
- RHYNCHONELLA PLICATILIS, *D'Orbigny*. Pal. Franç., Ter. Crétacés, vol. iv, pl. 499, figs. 9—12; and Prodrome, vol. ii, p. 257, 1850.
- TEREBRATULA OCTOPLICATA and T. PLICATILIS, *Tennant*. A Strat. List. of Brit. Org. Remains, p. 47, 1847.
- — *Dixon*. Geol. of the Fossils of the Tertiary and Cretaceous Formation, pl. xxvii, fig. 16, 1850.
- PLICATILIS, *Kner*. Natur. Abhand., tab. v, figs. 5, 6, 1850.
- OCTOPLICATA, *Alth*. Ib., p. 255, 1850.

Diagnosis. Shell transversely oval, with its greatest width towards the centre; *ventral*

or *dental* valve less inflated than the opposite one, with a shallow sinus; beak short, acute, and moderately incurved; foramen small, almost contiguous to the umbo, and entirely surrounded by the deltidium and its tubular expansions; beak ridges well defined, leaving a flattened space or false area between them and the hinge line. *Dorsal* or *socket* valve, generally more gibbose than the opposite one, its uniform convexity being interrupted from about the middle of the valve to the front, by a widely slightly produced mesial fold. The hinge line of the ventral valve indents the lateral portions of the umbo; margins flexuous on approaching the front, become sharply bent at almost right angles, indenting to a considerable extent the frontal edge of the dorsal valve. Externally, each valve is ornamented by from fifty to sixty plaits; these commonly, on approaching their terminations, become flattened, and, as if divided by a narrow longitudinal split or depression. In the interior of the dorsal valve, two curved processes exist for the support of the spirally coiled extensile arms. Shell structure impunctate.¹

Dimensions variable: length 12, width 15, depth 9 lines.

„ 11, „ 12, „ 12 „

Var. OCTOPLICATA, Sow. Plate X, figs. 1—17.

This variety agrees in general character with *R. plicatilis* (type), but differs more often by its plaits, which, on approximating, the front and lateral margins unite two by two, forming fewer and larger costæ; these last are also commonly acute, and not flattened or split, as is very often the case in the typical specimens of *R. plicatilis*.

Var. WOODWARDII, Dav. Pl. X, figs. 43—46.

TEREBRATULA GALLINA, *Woodward*. An Outline of the Geol. of Norfolk, tab. iv, fig. 12, 1833.

Diagnosis. Shell transversely oval: valves moderately convex, with a shallow sinus in the ventral, and slightly produced mesial fold in the opposite one. Externally each valve is ornamented by from 24 to 44 simple plaits, often split close to the margin; length 9, width 10 to 12, depth 6 to 7 lines.

Obs. It was justly observed by the author of the ‘Pal. Française,’² that Sowerby’s

¹ Dr. Carpenter has described and figured the remarkable shell structure observable in this species, in his very valuable memoir “On the Microscopic Structure of Shells.” (‘British Association’ for 1844, pl. xiv.) See also the “Introduction” to this work, pl. v, fig. 6.

² ‘Terrains Crétacés,’ vol. iv, p. 58, 1847; but prior to M. D’Orbigny, Dr. Mantell had stated 1822, that *R. octoplicata* was only a var. of *R. plicatilis*, “the specimens in my possession vary so much in the number of plica, and the convexity of the valves, and the characters of each are so equally blended, in many examples, that I have been obliged to consider them as only a variety of the same species (Fossils of the South Downs). Mr. Morris and Dr. Bronn have likewise arrived at similar conclusions, but we cannot admit all the synonyms mentioned by the learned German author, viz., *T. latissima*, *parvirostris*, *Martini*, and *nuciformis*.” Geinitz likewise looks upon *R. octoplicata*, as a var. of *R. plicatilis*, but erroneously adds *T. pisum*, Sow. and *T. Mantelliana*, Sow., two well-distinguished species.

descriptions and figures of *Ter. plicatilis* and *T. octoplicata* are so entirely similar, that no one is able to perceive in them distinguishing features. *R. plicatilis* varies to a considerable extent, as do all Brachiopoda, and it is not unusual to meet perfectly adult individuals of various dimensions as well as convexity, due, no doubt, to more or less favorable conditions of existence. After much examination I entertained a similar opinion to that already expressed by several Palæontologists, viz., that those examples in which, at a certain age, the plaits became united two by two near the front and lateral margins, could only constitute a simple variety of *Rh. plicatilis*, especially as a similar tendency is common to individuals of various forms, as for instance, *R. latissima*, Sow., &c. This complex plication does not always take place only in those examples in which the plaits are acute to the very edge. Nor do all specimens of true *Rh. plicatilis* present the split condition of the plicæ above described, although such may be the prevalent character in most examples. The term *octoplicata* is in itself essentially ill-chosen, from the positive fact that nothing is more variable than the number of plaits, and as an illustration of which I have figured in Pl. X a series of examples collected in the same locality by Mr. Fitch, with 3, 5, 6, 7, 8, and 9 plaits on the mesial fold, and specimens with exactly 8 plaits are by no means the most abundant. Although I have not yet obtained in England examples of *R. plicatilis* quite as large as some of its variety *octoplicata*, still in other countries typical specimens of *R. plicatilis* have been found equalling in dimensions any of those of the variety (Pl. X, figs. 1 and 3).

I must, however, here observe that Mr. S. P. Woodward differs from the conclusions we have arrived at, and is of opinion that *R. octoplicata* can be distinguished and should be preserved as a separate species from *R. plicatilis*. Associated with the shell last mentioned we often find another form, figured in 1833 by Woodward as *Tereb. Gallina* (Brong.),¹ but which, although somewhat similar in external contour to the Sowerby species, appears to possess a facies of its own, and, if not specifically distinct from *R. plicatilis*, would, at any rate, constitute a well-marked variety, being distinguished by fewer plaits, which are proportionally wide, with flattened ridges, and usually split near the margins.

Plate X, figs. 37 to 39. Typical example of *R. plicatilis*, from the Chalk of Brighton.

„ fig. 40. Front view of a very inflated individual, from the Kentish Chalk, in the collection of Mr. Bowerbank.

„ figs. 41, 42. An unusually expanded var., likewise from the Kentish Chalk.

„ figs. 1 to 11. A series of examples of the var. *octoplicata* (of authors), from the Norwich Chalk, in the collection of Mr. Fitch; figs. 1 and 3 are the largest British specimens I have seen.

„ figs. 12, 13. A young flattened example, from the Chalk at Royston (Cambridgeshire), in the British Museum.

„ fig. 16. A specimen, exhibiting spots attributed to colour? from the Chalk of Norwich.

¹ 'An Outline of the Geol. of Norfolk, pl. vi, fig. 12.—See likewise our Pl. X, figs. 43 to 46.

Plate X, fig. 17. A fragment of the beak (enlarged) to illustrate the tubular expansion of the deltidium.

„ fig. 14. Interior of the dorsal valve, from a specimen in the British Museum.

„ fig. 15. Interior of the ventral valve, ib.

„ figs. 43, 44. *Var. Woodwardii*, from the Chalk of Norwich, in the collection of Mr. Fitch.

„ figs. 45, 46. Ib. From the Chalk of Charing, in the cabinet of Mr. Harris.

35. RHYNCHONELLA LIMBATA, *Schlotheim*, Sp. Pl. XII, figs. 1—5.

TEREBRATULITES LIMBATUS, *Schlotheim*. Leonhard's Tash., vol. vii, p. 113, 1813; Petrjk. i, 286, reference Faujas, Mont St. Pierre, pl. xxvi, fig. 4, 1799.

TEREBRATULA SUBPLICATA, *Mantell*. Fossils of the South Downs, p. 211, tab. xxvi, fig. 5, 1822.

— — *Woodward*. A Synoptical Table of Brit. Org. Remains, p. 22, 1830.

— LENTIFORMIS, *Woodward*. Geol. of Norfolk, tab. vi, fig. 11, 1833.

— SUBPLICATA and LENTIFORMIS, *Morris*. Catalogue, 1843.

RHYNCHONELLA SUBPLICATA, *D'Orbigny*. Pal. Franç., Terrains Crétacés, vol. iv, p. 48, pl. 499, figs. 13—17 (under the false name of *Rhynch. dutempleana*), 1847.

TEREBRATULA LIMBATA, *Bronn*. Index Pal., vol. 2, p. 1246, 1848.

Diagnosis. Shell more or less transversely oval; somewhat trigonal or circular when young; beak short, narrow, and incurved; foramen minute, close under the acute extremity of the beak, and entirely surrounded by the deltidium and its tubular expansions. A flattened space occurs between the beak ridges and hinge line: valves moderately convex, with a longitudinal sinus in the ventral valve, to which corresponds a mesial fold in the opposite one: external surface entirely smooth when young, and often remaining so to an advanced age: from 10 to 20 short rounded plates ornament the vicinity of the margin; 3 to 5 occupying the mesial fold and sinus.

Dimensions variable: length 9, width 12, depth 6 lines;

„ 8, „ 9, „ 5 „

„ 5, „ 5, „ $2\frac{1}{2}$ „ (*T. lentiformis*, Woodward.)

Obs. Faujas St. Fond appears to have been the first author who figured this form, but without a name. In 1813, Schlotheim applied to it the denomination of *Terebratulites limbatus*, referring at the same time to Faujas's figure; this name is therefore the oldest we are acquainted with, and has a right to priority, as admitted by Prof. Bronn.

In 1822, the same species was described and figured by Dr. Mantell, under the name of *Ter. subplicata*, by which denomination it is known to the greater number of British and Foreign Palæontologists. Dr. Mantell states it to be well characterised by its smooth

surface and elevated plicated front. *Rh. limbata* is, however, very nearly related to *R. Octoplicata*, Sow., of which it may perhaps only constitute a marked variety, in which the greater portion of the surface is either entirely smooth, or indistinctly plicated, except towards the front and lateral margins. In 1833, a small race, almost completely circular in shape, and of the dimensions of a flattened pea, was named *Ter. lentiformis* by Woodward.

In the 'Pal. Franc.' vol. iv, p. 46, M. D'Orbigny considers the name *subplicata* to be a synonyme of *Rh. octoplicata*; but in p. 48 of the same work, he admits the species to be distinct, and in both cases refers to Dr. Mantell's name and figure. *Rh. limbata* abounds in the Upper Chalk of many localities, always associated with *Rh. octoplicata* (Sow.). It has been collected at Norwich, in Kent, Sussex, in Ireland, at Meudon and Chavot (France), &c. Ciply, in Belgium, is the locality from which Faugas's figured specimen was obtained, &c.

Plate XII, figs. 1, 2, 3. Specimens from the Norwich Chalk, in the collection of Mr. Fitch; fig. 1, enlarged.

„ figs. 4, 5. Young specimens, or a dwarf race (*Ter. lentiformis*, Woodward).

36. RHYNCHONELLA COMPRESSA, *Lamarck*, Sp. Pl. XI, figs. 1—5, and Pl. XII, fig. 25.

- TEREBRATULA COMPRESSA, *Lamarck*. An. sans Vert., vol. vi, p. 256, No. 54, 1819; and *Davidson*, "Notes on an Examination of the Lamarckian Species of Fossil Terebratulæ," Annals and Mag. of Nat. Hist., June, 1850, pl. xv, fig. 54.
- DIFFORMIS, *Lamarck*. Ib., vol. vi, No. 48, 1819 (Encycl. Méth., pl. 242, fig. 5, 1789); and *Dav.* Ib., June, 1850, pl. xv, fig. 48.
- DIMIDIATA, *Sowerby*. Min. Con., tab. 277, fig. 5, 1821.
- — *Parkinson*. An Introd. to the Study of Organic Remains, p. 234, 1822.
- GALLINA, *Brong.* Desc. Géol. des Environs de Paris, p. 84, pl. ix, fig. 2, 1822.
- COMPRESSA, *Defrance*. Dic. des Sc. Nat., vol. liii, p. 158, 1828.
- DIMIDIATA, *Fleming*. A Hist. of British Animals, p. 372, 1828.
- DIFFORMIS, *Defrance*. Dic. Sc. Nat., vol. liii, p. 160, pl. v, fig. 3, 1828.
- DIMIDIATA, *Woodward*. Synoptical Table of Br. Organic Remains, p. 21, 1830.
- DIFFORMIS, *Deshayes*. Encycl. Meth., iii, p. 1029, No. 22, 1832.
- ALATA, *V. Buch.* Class. des Térébratules, Mém. Soc. Géol. de France, vol. iii, p. 150, pl. xv, fig. 21, 1834.
- COMPRESSA, *Deshayes*. Nouv. Ed. de Lamarck, vol. vii, p. 345, No. 54, 1836.
- DILATATA, *Sowerby*, in *Fitton*. Trans. of the Geol. Soc. of London, vol. iv, p. 343, pl. xviii, fig. 2, 1836.
- DIFFORMIS. Des. Nouv. Ed. de Lamarck, vol. vii, p. 343, No. 48, 1836.
- DIMIDIATA, *Morris*. Catalogue, 1843.

- RHYNCHONELLA COMPRESSA, *D'Orbigny*. Pal. Franç., Ter. Crétacés, vol. iv, p. 35, pl. 497, figs. 1—6, 1847.
 — DIFFORMIS, *D'Orbigny*. Ib., vol. iv, p. 41, pl. 498, figs. 6—9, 1847.
 TEREBRATULA COMPRESSA, *Bronn*. Index Pal., p. 1233, 1848, (but not a Syn. of *T. limbata*.)

Diagnosis. Shell depressed, elongated oval, wider than long, angular at the cardinal, dilated towards the pallial, region, somewhat indented in front; the greatest width and depth lying towards the middle of the shell: valves unequally convex, the dorsal one generally the deepest, with a wide, slightly produced, and flattened mesial fold, occupying about one third of the width of the shell: in the *ventral* valve, a corresponding wide longitudinal sinus: beak acute, moderately produced, and incurved: foramen rather small, and entirely surrounded by the deltidium: beak ridges sharply defined, leaving a flattened space between them and the hinge line: externally each valve is ornamented by from 32 to 48 strong simple plaits, 8 to 11 of which compose the mesial fold and sinus.

Dimensions variable: length 17, width 23, depth 8 lines.

„ 13, „ 18, „ 10 „

Obs. This fine species was described by Lamarck, in 1819, from specimens derived from the Upper Green Sand of Mans (France): it varies greatly in degree of compression, some examples being considerably flattened, while others are more convex, and this last variety is the one commonly found both at Chute, near Warminster, and Cap-la-Heve, near Havre (France). A similar shell was described at a later period (1836) by Sowerby, under the name of *Ter. dilatata*, and *Ter. Gallina* (Brongniart) seems likewise to belong to the same type. *R. compressa* is not always regularly trilobed, but often unsymmetrical, from the mesial fold becoming totally or partially shifted either to the one or other side; the shell then appears divided, as in *Rh. inconstans*, into two portions, one half occupying a higher level than the other, or with one edge turned up and the other down; a malformation so common among the *Rhynchonellæ* that it cannot be made use of as a character of any specific importance: thus *Terebratula difformis*¹ (Lamarck), and *Ter. dimidiata* (Sowerby), are nothing more than irregularly developed examples of *R. compressa*, of which any one will become convinced who may examine the typical specimens in

¹ M. D'Orbigny seems to consider *Rhyn. difformis* (Lamarck) to be specifically distinct from *R. compressa* of the same author, and states p. 42, vol. iv, of the 'Pal. Franç.,' "Cette espèce (*R. difformis*) se distingue du *T. contorta* par ces côtes plus grosses. Lorsqu'elle est régulière, elle se rapproche du *R. compressa*, mais elle diffère par sa forme plus renflée encore, est plus courte, moins dilatée latéralement, c'est une espèce bien séparée, mais très variable dans sa forme." Lamarck observes, that his specimens of this shell were derived from the Green Sand of Cap-la-Heve (near Havre), and likewise from Mans. And in both localities I have had the opportunity of examining and collecting specimens, uniting these malformations by insensible passages to the regularly developed condition of *R. compressa*; and both in the French and British localities we find unsymmetrical individuals likewise more or less flattened, as is the case with well-shaped examples.

the Lamarckian and Sowerby collections, or from the study of a series of specimens derived from the localities in which *R. compressa* occurs.¹

In England, *R. compressa* is found in the Upper Green Sand of Chute Farm, near Horningsham, at Halldown, in the Chloritic Marl of Chard, and other localities. On the Continent, it abounds at Havre, Mans, and la Flèche (Jarthe). M. D'Orbigny also states he has found it at Lattes, La Malle, and Escagnolles (Var.), at l'Ile Madame, Ile d'Aix, and at the Pont des Barques (Charente Inférieure).

Plate XI, fig. 1. A well-shaped example, from the Upper Green Sand near Warminster, in the collection of Mr. Cunningham; it is identical in shape to some found at Havre.

„ fig. 2. A very large individual, from the same locality, similar to the one figured by Dr. Fitton as *T. dilatata*, Sow. (Geol. Trans., vol. iv, pl. xiv, fig. 2.)

„ fig. 3. Front view of a specimen from Chute Farm, in which the mesial fold is shifted to one side, from the cabinet of Mr. Cunningham.

„ fig. 4. A malformation from the Chloritic Marl of Chard, which entirely agrees with Sowerby's type of *Ter. dimidiata*.

„ fig. 9. Another similar example, from the Upper Green Sand near Warminster.

Plate XII, fig. 25. A specimen from the Chloritic Marl of Chardstock, in the collection Mr. Th. Walrond.

37. RHYNCHONELLA LATISSIMA (*lata*), Sow., Sp. Pl. XI, fig. 6—22, and Pl. XII, fig. 24.

TEREBRATULA LATA, Sow. Min. Con., vol. v, p. 165, tab. 502, fig. 1, 1825, changed afterwards (1829) to *Ter. latissima*, by the same author (not *Ter. lata*, Sow., Min. Con. vol. i, pl. 100, fig. 2, 1812).

— ALATA? Nilsson. Petrefacta Suecana, pl. iv, fig. 9, 1827.

— LATA, Sow. (in Fitton). Trans. Geol. Soc., vol. iv, pl. xiv, fig. 11, 1836.

— CONVEXA, Sow. Ib., pl. xiv, fig. 12, 1836.

— LATISSIMA, Roemer. Die Vers. Nord. Kreid., pl. vii, fig. 4, 1840.

— — Morris. Catalogue, 1843.

— — D'Archiac. Mém. Soc. Géol. de France, vol. ii, 2d ser., p. 330, pl. xxi, fig. 7, 1847.

— SCALDINENSIS. Ib., pl. xx, fig. 11.

¹ Some authors have attributed to this species *Rhyn. alata* (Lamarck, sp.); but as observed by MM. D'Orbigny, Deshayes, and myself, *T. alata* is nothing more than a synonyme of *Rhynchonella* (*Anomya*) *vespertilio* of Brocchi ('Conchologia Fossile,' 1814). Lamarck refers to pl. 245, figs. 2, *a*, *b*, of the 'Ency. Méthodique,' which figure certainly represents a shell identical with the one illustrated by the Italian author. *R. vespertilio*, at times, bears some resemblance to *R. compressa*, but is in general more regularly convex and trilobed, with a much deeper sinus, and a more elevated mesial fold.

RHYNCHONELLA LATA, *D'Orbigny*. Pal. Franç., Ter. Crétacés, vol. iv, p. 21, 1847 (but perhaps not all his list of Synonymes).

TEREBRATULA PLICATILIS, *Bronn*. Index Pal., p. 1246, 1848 (but not *T. plicatilis*, Sow., nor the generality of Bronn's other synonymes).

— LATA, *Austen*. Quart. Journ. Geol. Soc., vol. vi, p. 477, 1850.

— LATISSIMA, *Sharpe*. Quart. Journ. of the Geol. Soc., vol. x, p. 192, 1853.

Diagnosis. Shell transversely oval or unequally five sided, with rounded angles: *ventral* or dental valve moderately convex: beak acute, slightly produced and incurved: foramen circular, entirely surrounded by the deltidium and its tubular projections: beak ridges well defined, leaving a flattened space between them and the hinge line: the regular convexity of the valve is interrupted by a sinus of moderate depth, commencing towards the middle and extending to the front. The *dorsal* or socket valve is either convex and regularly arched, or somewhat flattened, with a mesial fold not rising much above the uniform convexity of the shell. Externally, the surface of each valve is ornamented by from 50 to 80 plaits.

Length 12, width 16, depth 7 lines;

„ 10½, „ 12, „ 7 „

„ 9, „ 10, „ 6 „ &c.

Obs. The shells here described may perhaps only constitute a variety of *R. compressa*, Lamarck: but they seem to be distinguished by a less expanded, and in general more regularly transverse oval shape; also by the number and quality of their plaits, which are more numerous in the shells under notice than in the Lamarckian type, which does not appear to present the complex condition at times observable in *R. latissima* (Sow.). So much so, that some examples illustrated in my Pl. XI, figs. 19—22, have been by some authors supposed to belong to another species, viz., *R. antidichotoma* of Buvignier,¹ but after having examined a numerous series of specimens collected by Messrs. Sharpe, Lowe, Waterhouse, Cunningham, myself, and others, I was able to convince myself in a most satisfactory manner, that all the examples illustrated in Pl. XI, figs. 6—22, belonged to the same species. In the extensive series principally derived from Warminster and Farringdon, every possible variation in the plication may be perceived: in almost all, the plaits are few in number in the young, but soon augment at variable distances from the extremities of the beak and umbo by the intercalation of a fresh plait between those already formed. In many examples, the last as well as the original ones proceed uninterruptedly to the margin, while in others, some of the intercalated ribs are lost, or disappear between their immediate neighbours before reaching the front or margin, while in some cases only a few while in other examples almost every two of the plaits unite, and form a belt of larger costæ near the front and margin. All these complex characters are accu-

¹ This shell differs from *R. latissima* by its general shape and small foramen, which is widely separated from the hinge line by a largely developed deltidium; also to some extent by the character of its plaits. See Pal. Franc. Terrains Crétacés, vol. iv, p. 500, fig. 1—4.

ASTARTE ROTUNDA. Tab. IX, fig. 12.

ASTARTE ORBICULARIS, *Sow.* Min. Con., t. 520, f. 2.— ROTUNDA, *Morris.* Catal. Brit. Foss., p. 187.

Testá crassá orbiculatá, convexá, umbonibus submedianis acutis, margine cardinali obliquo, elongato, subrecto, lunulá magná lanceolatá, plicis incrementi paucis, irregularibus; costis depressis, crebris et irregularibus.

Shell thick, orbicular, convex; umbones nearly mesial, prominent, acute; hinge margin oblique, lengthened, and nearly straight; lunule large and lanceolate; folds of growth few and irregular; costæ depressed, small, closely arranged, and irregular.

The general figure has a considerable degree of convexity; the umbones are small, pointed, and curved forwards, and are placed somewhat nearer to the anterior than posterior side of the valves; the extremity of the lengthened hinge border forms an angle with the inferior margin. It is rare.

Height nearly equal to the lateral diameter, which is $2\frac{1}{4}$ inches; the diameter through both the valves is $1\frac{1}{2}$ inch.

Locality. Minchinhampton Common, in the planking.

ASTARTE? RHOMBOIDALIS, *Phil.*, sp. Tab. IX, fig. 20.ISOCARDIA RHOMBOIDALIS, *Phil.* Geol. York., 1, t. 3, f. 28.HIPPOPODIUM LUCIENSE, *D'Orb.* Prod. Paléont., p. 308.— BAJOCIENSE, *D'Orb.* Ib., p. 277.

Testá crassá convexá, subquadrátá, vel oblongá, umbonibus anticis obtusis, margine cardinali elongato, subhorizontali, lunulá magná, excavatá, margine inferiore subrecto et sinuato, marginibus internis integris, superficie plicis incrementi paucis, magnis, distantibus; striis concentricis tenuissimis regularibus crebris. Ætate senili striis concentricis obsoletis, plicis rugis magnis irregularibus.

Shell thick, convex, subquadrate, or oblong; umbones anterior, obtuse; hinge margin elongated, subhorizontal, but slightly arched; lunule large, elliptical; inferior margin nearly straight, parallel to the superior border, and slightly sinuated; internal margins of the valves plain, acute; folds of growth few, large, and distant; concentric striations regular, delicate, and closely arranged. In an advanced stage of growth the concentric striations disappear, and the surface became rugose with the irregular plications of increase. An oblique prominence or obscure angle extends downwards posteriorly; and becomes prominent in specimens which are short and have the superior border much arched. The Great Oolite examples are very numerous, and for the most part rather flattened and rugose with adherent shells, the largest specimens not unfrequently having been perforated or grooved by the Lithophagidæ; the substance of the test is very thick, and the muscular impressions are deeply excavated; the cardinal teeth are remarkably large and massive.

and it is possible that the author of the 'Pal. Franc.' may have considered as belonging to the same species, shells named *R. parvirostris* and *R. Gibbsiana*, which appear with us distinct, and peculiar to the Lower Green Sand (Neocomien of the French).

The figures published by Viscomte D'Archiac of his *Rh. Scaldinensis* entirely agree with our typical examples of *R. latissima*, and much more closely so even than the figures he attributes to the Sowerby species. The celebrated author of the 'Histoire des Progrès de la Géologie,' mentions that his *Ter. Scaldinensis* numbers as many as 65 plaits, while Sowerby only mentions 40 to his *R. latissima*, but from what I have said above, it may be seen that the plaits in our British species vary very much, and are often as numerous as in *R. Scaldinensis* of the French author.

Plate XI, figs. 6, 7, 8, and 14. Different specimens and shapes of *R. latissima*, from the Upper Green Sand of Warminster.

- „ figs. 9, 10, 11. Young specimens, from same locality.
- „ fig. 12. Unsymmetrical and aged example, same locality.
- „ fig. 13. A malformation, from Warminster, from the cabinet of Mr. Cunnington.
- „ fig. 15. A ventral valve from Farringdon.
- „ fig. 16. A convex variety, same locality.
- „ fig. 17. Profile and front view of another Farringdon specimen, in the collection of Mr. Lowe. Fig. 17^c, an enlarged illustration, to show exactly the complex condition of the plaits.
- „ fig. 18. A young specimen from Farringdon.
- „ figs. 19 and 20. A specimen from the same locality, in the collection of Mr. Lowe, in which the complex plication above described is well exemplified, and especially so in the enlarged figure 19^c.
- „ figs. 21 and 22. Two other examples from the same locality, in the collection of Mr. Sharpe. *R. Antidichotoma*, Buv.? according to Mr. Sharpe.

Plate XII, fig. 24. A very remarkable example, from the Chloritic Marl of Chardstock, in the collection of Mr. Wiest.

38. RHYNCHONELLA SULCATA, *Parkinson*, Sp.? Plate X, figs. 18—36.

TEREBRATULA SULCATA, *Parkinson*. Trans. Geol. Soc., vol. i, p. 347, 1811, and vol. v, p. 57, 1821 (but neither figured nor described).

— — *Morris*. Catalogue, 1843.

RHYNCHONELLA SULCATA, *D'Orbigny*. Pal. Franç., Ter. Crétacés, vol. iv, p. 36, pl. 495, figs. 1—7, 1847.

Diagnosis. Shell transversely oval, wider than long; valves more or less unequally convex, *ventral* or dental valve in general the deepest, with a shallow longitudinal sinus to which a moderately produced mesial fold corresponds in the opposite one. Beak short,

acute, entire, and but little incurved; foramen small, surrounded by a deltidium in two pieces; beak ridges well defined, the hinge line not encroaching on that of the dorsal valve; lateral margins slightly flexuous; the frontal edge of the ventral valve indenting more or less that of the dorsal one. External surface ornamented by a number of simple radiating plaits, from 30 to 40 on each valve.

Length 12, width 15, depth 10 lines. (This species at times attains somewhat larger dimensions.)

Obs. In 1811, Parkinson simply mentioned the name *Terebratula sulcata*, without description or figure. And in another paper, read before the Geological Society in 1818, but published only in 1821, we find the same name repeated, as follows:

“FOSSILS IN THE BLUE MARL. *Terebratula sulcata*, found near Dover, Folkstone, and Cambridge,” but no figure or description is given, so that this appellation is in reality equivalent to a MS. denomination, and the author may have intended the shell for the one afterwards named *T. Mantelliana* by Sowerby, and which is found in those localities.

In the ‘Geology of Sussex,’ p. 130, 1822, Mantell likewise describes a *Rhychonella* by the name of *sulcata*, from the Chalk of Hamsey and Stoneham in Sussex, but also without figure, and to this species the name *T. Mantelliana* was subsequently appended by the author of the ‘Min. Con.,’ that of *Ter. sulcata* being retained for another shell found abundantly in the Upper Green Sand of Cambridge.

In 1843, Mr. Morris mentioned *Ter. sulcata* as from the Gault of Folkstone and Cambridge: and in 1847, M. D’Orbigny describes the Upper Green Sand Cambridge species as that of Parkinson; considering at the same time *Rh. Gibbsiana* (Sow.) a synonyme; but here the learned author of the ‘Pal. Franc.’ seems to be evidently mistaken. The *R. Gibbsiana* (Sow.) occurs, it is true, in the vicinity of Folkstone, Sandgate, Hythe, &c., but in another bed, viz., Lower Green Sand (Neocomien), and cannot, I believe, be confounded with the Upper Green Sand species, now so well known to collectors as the true (?) *R. sulcata* of Parkinson. In a catalogue of the *Lower Green Sand* fossils in the museum of the Geological Society,¹ Professor Forbes stated that *R. sulcata* occurs in the *Lower Green Sand* of Hythe, and mentioned as his var. β , *R. parvirostris* of Fitton, a view I can hardly admit. Professor Bronn,² while adopting the term *sulcata*, states it to be his opinion that *R. depressa* (Sow.), *inconstans*, *rostralina*, *plicatella*, and *multiformis* (Rœmer), as well as *T. parvirostris* and *elegans* (Sow.) belong all to the same type; and although perhaps some of the shells mentioned may bear a resemblance to our Upper Green Sand species, neither *R. elegans*, *parvirostris*, nor *depressa* can I think, with propriety, be united to the Cambridge *R. sulcata*.

Rh. Gibbsiana is more triangular in its external aspect, its sinus and fold much more

¹ Quarterly Journal of the Geol. Soc., vol. i, p. 345, 1845.

² Index Pal., vol. ii, p. 1852; — 1848.

developed, and the plaits always smaller and more delicate than those observable on the Cambridge shell, which it has been agreed to term *R. sulcata*.

Few species vary more in external shape or detail than the one under consideration, as may be seen from the series of illustrations I have selected from among several hundred individuals assembled from a single locality by Mr. Carter. The mesial fold and sinus does not always occupy the middle of the shell, nor in all cases is it symmetrical, for out of ten examples eight or nine will have their fold and sinus shifted more to the one or the other side, as seen in figs. 23, 25, and 27 of our Plate, while in some examples the one half of the valve is more elevated than the other, being twisted indifferently to the right or to the left, as is so common to *Rh. inconstans*, and to those malformations of *Rh. compressa* to which Sowerby had applied the term *R. dimidiata*. The plaits are generally simple, but in some instances, although rarely, bifurcate here and there.

Rh. sulcata abounds in the *Upper Green Sand* near Cambridge, is less commonly met with in the neighbourhood of Warminster, and was found by Mr. Bean in the Speeton Clay of Yorkshire. Some rare examples have likewise been found in the Gault of Folkstone, and in the corresponding bed at Wissant, on the French coast. M. D'Orbigny mentions the species as abounding in his TERRAIN ALBIEN at Grandpré, and Fleville (Ardennes), Gérodot (Aube), at the Perte du Rhône (Ain), and Clausayes (Drome), &c.

Plate X, figs. 18—20, and 23—36. Illustrate a series of specimens from the Upper Green Sand of Cambridge, in the cabinet of Mr. Carter. Figs. 18, 21, are regular in shape, the others show some of its innumerable malformations. Figs. 15 and 36 are internal casts, on which the muscular and vascular impressions are well preserved.

„ figs. 21—22. From the Speeton Clay, in the collection of Mr. Bean.

39. RHYNCHONELLA MANTELLIANA, Sowerby, Sp. Plate XII, figs. 20—23.

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|--------------|--------------|------------|---|
| TEREBRATULA | MANTELLIANA, | Sowerby. | Min. Con., vol. vi, p. 72, tab. 537, fig. 5, 1825. |
| — | — | Fleming. | A Hist. of British Animals, vol. i, p. 374, 1828. |
| — | — | V. Buch. | Mém. Soc. Géol. de France, vol. iii, p. 154, pl. xv, fig. 26, 1838. |
| — | — | ? Geinitz. | Char. Kreid., p. 15, 1839. |
| — | — | Morris. | Catalogue, 1843. |
| RHYNCHONELLA | MANTELLIANA, | D'Orbigny. | Pal. Franç., Ter. Crétacés, vol. iv, p. 40, 1847, (the illustrations given by this author, pl. 498, figs. 1—5, do not recall the common aspect of the Sowerby species.) |

Diagnosis. Shell transversely obovate, rather wider than long; valves almost equally

convex, with a shallow longitudinal depression or sinus in the dental or ventral valve, which corresponds to a slightly produced mesial fold in the opposite one. Beak short, entire, not much incurved, foramen small, and entirely surrounded by the deltidium: lateral margins almost straight: the frontal edge of the ventral valve encroaches on that of the dorsal one. Externally each valve is ornamented by from 15 to 18 wide simple plaits, 3 or 4 forming the mesial fold. Dimensions very variable: length 7, width 8, depth $4\frac{1}{2}$ lines.

Obs. This species was accurately described and figured by Sowerby, in the 'Mineral Conchology,' under the name of *Ter. Mantelliana*; and it is most probably one of the shells intended by Parkinson as the type of his *Ter. sulcata*, but as the last-named author neither described nor figured his form, Sowerby's denomination must be retained for the well-known species under consideration.

Rh. Mantelliana is commonly a small shell, of about the dimensions above given, but it has been found sometimes, although rarely, of larger dimensions, as proved by the fine specimen (Pl. XII, fig. 23) found in the Lower Chalk near Lewes, by Mantell, and it forms part of his collection in the British Museum; it abounds in the Lower Chalk and Chalk Marl between Dover and Folkstone, at Hamsey, and in many other localities, and has been collected, although much more rarely, in the Upper Green Sand of the neighbourhood of Warminster, and in the Chloritic Marl of Bonchurch (Isle of Wight), by Mr. S. H. Saxby. On the Continent, it occurs in beds of a similar age to those above mentioned, both in France and Belgium. *Rh. Mantelliana* is well distinguished from *Rh. Cuvieri*, by its larger and less numerous plaits, as well as by its greater width.

Plate XII, fig. 20 and 21. Two examples from the Gray Chalk of Folkstone and Hamsey.

- „ fig. 22. A specimen from the Upper Green Sand of Chute Farm, near Warminster, in the collection of Mr. Cunningham.
- „ fig. 23. A very large specimen, from the Lower Chalk of Lewes, in the Mantellian collection in the British Museum. It measures: length 10, width 11, depth $6\frac{1}{2}$ lines.

40. RHYNCHONELLA CUVIERI, *D'Orbigny*. Plate X, figs. 50—54.

TEREBRATULA PISUM, *Geinitz*. Kreide, pl. xvi, fig. 18, 1840 (but not *Ter. pisum*, Sow.).

RHYNCHONELLA CUVIERI, *D'Orbigny*. Pal. Franç., Ter. Crétacés, vol. iv, p. 39, pl. 497, figs. 12—15, 1847.

Diagnosis. Shell small, transversely or longitudinally oval, length and width often the same: valves regularly convex, and of nearly equal depth, a shallow depression or sinus existing towards the front of the dental or ventral valve, to which a similar slight elevation corresponds in the opposite one; beak small, acute, and entire; foramen minute, completely surrounded and removed from the contiguity of the hinge line by a deltidium and

In none of the Oolitic forms do we find a greater variety of figure than in this species, and without ample materials for comparison, its examples would probably be regarded as pertaining to more than one species; these variations, which are irrespective of growth, refer to the degree of convexity, the extent to which the valves are produced posteriorly, and the more or less compressed and angulated, or, on the other hand, rounded and convex figure of the posterior side of the shell. The valves occur in such considerable numbers, and so fully illustrate all these minor variations of figure, as to remove all doubt that they belong to the same species, even though we place together two examples of very dissimilar aspect. The shell is rather thin, always very fragile, except at the umbones, which are not unfrequently the only portions preserved when the shelly beds are more than usually detrital in their character. The valves rarely occur in contact; but when this happens the ligament is preserved.

The subjoined proportions must be regarded as representing the median figure of the species. Height, 13 lines; lateral diameter, 15 lines; diameter through both the valves, 10 lines. It ranks as one of the most abundant of the bivalves in the Minchinhampton district, and ranges throughout the shelly beds. Named after J. G. Lowe, Esq., who has assiduously collected an interesting series of fossils from the middle Oolite.

Localities. Minchinhampton Common; Bisley Common.

CYPRINA TRAPEZIFORMIS, et var. SUBROTUNDA. Tab. XIII, fig. 5, 5a, c.

VENUS TRAPEZIFORMIS, Roemer. Verst. Nordd. Oolith., t. 7, fig. 14.

Testá orbiculato-subtrapeziformi, convexo-planá; antice rotundatá; postice subproductá, angulo acuto carinato-depresso; umbonibus anticis incurvis.

Shell orbicular or subtrapeziform, moderately convex; anterior side rounded; posterior side somewhat produced, forming a depressed angle; umbones anterior, incurved.

This small species occurs abundantly throughout the shelly beds of the formation at Minchinhampton, with the valves disunited. When well preserved, its surface exhibits concentric, irregular, and very fine striations; it is shorter and more convex than *C. Loweana*. The form which we have designated as a variety has greater convexity, and the posterior side has not the angulated outline of the typical form.

Dimensions of this variety: height, 8 lines; lateral diameter, 9 lines; diameter through both the valves, 7 lines. Another line added to the lateral diameter will represent the typical form.

Localities. Minchinhampton Common; Bisley Common.

CYPRINA JURENSIS, Goldf., sp. Tab. XIII, fig. 3.

VENUS JURENSIS, Goldfuss. Petref., p. 245, t. 150, fig. 17.

Testá parvâ suborbiculari; umbonibus medianis minutis; lunulâ ovatâ; areâ lanceolatâ.

the *ventral* or dental one with a wide longitudinal sinus, to which corresponds a slightly raised mesial fold in the opposite or dorsal valve: beak acute, tapering and but slightly incurved, ridges sharply defined, leaving a wide flattened space or false area between them and the hinge line, which last indents the lateral portions of the umbo: foramen comparatively large, entirely surrounded, and more or less removed from the hinge line by the deltidium and its tubular prolongations; lateral margins moderately sinuous; the frontal edge of the ventral valve indents the opposite one to a lesser or greater extent. Externally, 17 to 30 plaits ornament each valve, 6 to 10 forming the mesial fold. Dimensions variable: length 8, width 9, depth 6 lines;

„ 7, „ $7\frac{1}{2}$, „ 4 „

Obs. The shell above described has been distinguished and admitted by British geologists as *Ter. depressa* of Sowerby,¹ although misunderstood by several continental authors. It may, however, remain a question whether *R. depressa* be really distinct from the *Anomites triangularis* of Wahlenberg,² a point I have been unable to determine, from the figures published by the Swedish author not conveying a sufficiently satisfactory resemblance to Sowerby's species and specimens, being too circular, and exhibiting no trace of mesial fold or sinus, which is always visible in examples of similar dimensions of *R. depressa*. Nilsson³ describes and reproduces Wahlenberg's figures, but does not throw further light on the contested question. The beak, foramen, and deltidium are both inaccurately and vaguely represented, for which reasons I did not consider it advisable to remove Sowerby's denomination until more positive evidence can be obtained by the inspection of Swedish specimens.

Mr. Sharpe considers that among the shells found at Farringdon, and referred by myself to *R. depressa*, the two species do occur, and may be distinguished; but after a minute study of all the specimens collected by that distinguished Palæontologist, as well as of those assembled in the locality by myself and others, I felt unable to arrive at a similar conclusion, from finding that all possessed (to my eyes) the same *essential* specific character. According to Mr. Sharpe, the young shell (Pl. XI, fig. 32) would represent *R. triangularis*, while the figs. 29 and 30, represent *R. depressa*; in these, however, we observe the same general shape, the same character of plication, with many of the plicæ augmenting by intercalation, and varying in number; a peculiarity common to specimens of every species

¹ "Triangular, depressed, regularly plaited, front elevated, lateral angles rounded, beaks produced, plaits 20; when so young that the front is hardly elevated, this shell is almost orbicular: in which circumstance it differs from the last (*Ter. lata*), the proportions of which do not vary much by age; the plaits are sharp, about eight of them are raised with the front. Found at Farringdon. ('Min. Con.,' vol. v, p. 165, tab. D ii, fig. 2.)

² 'Petrifacta Telluris Suecana, Nova Acta Regiæ Societates Scientiarum Upsaliensis, vol. viii, tab. iii, figs. 11, 12, 13, 1821.

³ 'Petrifacta Suecana,' p. 36, tab. iv, fig. 10, 1827. "T. testa ovato-triangulari, longitudinaliter sulcata; sulcis et interstriis numerosissimis æqualibus; valva minore convexiore; rostro acutangula subrecto; margine superiore; bex sinuato. Locality—Balsberg," where it is stated to be rare.

of Rhynchonella, and, had space permitted, illustrations could have been introduced exhibiting every passage uniting such shells as figs. 28 and 30. In all, the umbo of the dorsal valve is much incurved, its extremity being to a lesser or greater extent concealed under the development or encroachment of the deltidium. On well preserved examples the concentric lines of growth are numerous and in close approximation, giving to the upper ridge of each plait a somewhat granulated appearance, but which is more deceptive than real, since these projections form part of an uninterrupted and continuous concentric line or ridge. In young individuals, no trace of sinus or mesial fold can be perceived, the frontal line being straight, but with age both the sinus and fold gradually appear, and always exist to a greater or lesser degree in adult individuals. Geinitz published two figures representing the exterior of the ventral valve of a shell he terms *Ter. Triangularis*,¹ and which in external contour appears to somewhat resemble our British examples, but the profile view would almost indicate a different species. M. D'Orbigny's figures² of his so-called *Rh. depressa* do not appear to resemble Sowerby's shells, and belong (I have little doubt) to a distinct species, although the description published in the 'Pal. Française,' would denote a shell different from that figured in his plate.

R. depressa abounds in the Upper Green Sand of Farringdon, along with *R. nuciformis*.

Plate XI, fig. 28. A specimen of *R. depressa*, Sow., from the Upper Green Sand of Farringdon, in the cabinet of Mr. Lowe, it presents 11 plaits on the mesial fold; 28^b & c are enlarged representations.

„ fig. 29. Another example from the same locality, in which the central plaits are narrower than the lateral ones.

„ fig. 30. A specimen with an unusually small number of plaits, from the collection of Mr. Sharpe; fig. 3^c, enlarged.

„ fig. 31. A young individual, from the same locality.

„ fig. 32. A young and somewhat elongated example, believed by Mr. Sharpe to represent *R. triangularis*; fig. 32^b a magnified illustration, from the collection of Mr. Sharpe.

Plate XII, fig. 26. A large transverse specimen, in which the beak is not so much produced as in those figured in Pl. XI, locality Farringdon.

In the Upper Green Sand of Warminster, in that of the Isle of Wight, and in equivalent beds at Chardstock, are found numerous examples of two forms represented in Pl. XII, figs. 28 and 30. They appear to constitute (if not separate species) well-marked varieties of *Rh. depressa* of Farringdon. I will therefore briefly mention them under the head of *varieties A and B*.

¹ 'Charact. der Schichten und Petref.,' pl. xix, figs. 1—3, 1842.

² 'Pal. Franç., Terrains Crétacés,' vol. iv, p. 18, pl. 491, figs. 1—7. M. D'Orbigny states that his specimens were obtained in the Terrain Néocomien of France.

compressed, elongated figure, and a hinge, the dentition of which differs materially from that of the better known forms of *Corbis*. The shells, likewise, are rather thin, the margins not toothed, and the posterior side is always the larger of the two.

TANCREdia TRUNCATA, *Lycett*. Tab. XIII, fig. 11.

TANCREdia TRUNCATA, *Lycett*. Ann. and Mag. Nat. Hist., 1850, pl. 11, f. 10.

Testá subtrigóná, ovato-cuneatá; umbonibus posticis; latere postico, brevi, truncato; antico elongato, margine superiore ejusdem recto, obliquè-declivi; margine inferiore subrecto.

Shell subtrigonal, or ovately wedge-shaped; umbones posterior; posterior side short, truncated; anterior side elongated, its superior margin straight, sloping obliquely downwards, the extremity rounded; basal margin nearly straight.

The short posterior side slopes suddenly downwards, it is bounded by an obscure angle or ridge.

Height, $6\frac{1}{2}$ lines; length, 13 lines; diameter through both the valves, 5 lines. Its position is the shelly beds of the Great Oolite, in which it is somewhat rare.

Localities. Minchinhampton and Bisley Commons.

TANCREdia BREVIS. Tab. XIII, fig. 8.

Testá parvâ subtrigónâ; umbonibus submedianis; latere postico brevi, angulo producto; marginibus acuminatis, margine inferiore elliptico.

Shell small, subtrigonal; umbones submesial, depressed; posterior side sloping obliquely, and having a prominent angle, which passes obliquely from the umbo to the postero-inferior border; margin of the valves pointed at both extremities, the inferior margin curved elliptically.

Compared with *T. axiniformis* this species is much more short and convex, and it always forms a prominent angle upon the posterior side, posterior to which the surface is flattened, or even slightly excavated, the extremities of the valves being pointed. In its geological range it accompanies the two other species; it is everywhere common, and certain layers of soft shelly Oolite beneath the planking of Minchinhampton Common are entirely covered with its valves; undoubtedly it is the most abundant bivalve in the district.

Length, $7\frac{1}{2}$ lines; height, $4\frac{1}{2}$ lines.

The *Tancredia donaciformis*, *Lycett*, 'Ann. and Mag. Nat. Hist.,' 1850, vol. vi, pl. xi, fig. 8, approximates so nearly to our species that it is necessary to discriminate between the two forms. The *T. donaciformis* is more lengthened, the umbones are mesial, but the anterior side is more attenuated, its marginal slope being slightly concave, and its extremity more pointed, so that the posterior side appears to be larger than the other; it occurs in the shelly free stone of the Inferior Oolite, Leckhampton Hill, in an abundance rivalling our Great Oolite species.

Locality. The whole of the Minchinhampton district.

42. RHYNCHONELLA NUCIFORMIS (*Sowerby*, Sp.). Plate XI, figs. 23—27, and Plate XII, fig. 27.TEREBRATULA NUCIFORMIS, *Sow.* Min. Con., vol. v, p. 166, tab. 502, fig. 3, 1825.— — *Woodward.* A Synopt. Table of British Org. Remains, p. 21, 1830.— — *Morris.* Catalogue, 1843.— — *Tennant.* A Strat. List of British Fossils, p. 47, 1847.— — *Austen.* Quart. Journ. of the Geol. Soc., vol. vi, p. 477, 1850.— — *Sharpe.* Quart. Journ. of the Geol. Soc., vol. x, p. 192, 1853.

Diagnosis. Shell more or less transversely oval and inflated: valves unequally convex, the dorsal one more often the deepest: beak acute, moderately produced and incurved: foramen almost contiguous to the umbo, of moderate dimensions, and entirely surrounded by the tubular prolongations of the deltidium: between the beak ridges and hinge line exists a flattened space, which slightly indents the lateral portions of the umbo.

The ventral or dental valve presents a longitudinal depression or shallow sinus, to which, in the opposite valve, a mesial fold corresponds of variable elevation: externally each valve is ornamented with from 30 to 40 plaits, 7 to 12 occupying the mesial fold or sinus, the ridges of the plaits are more or less acute, but, on approaching the front and lateral margins, often become flattened, with a longitudinal indented line along their centre. Dimensions and relative proportions very variable: length, $6\frac{1}{2}$, width, 7, depth, 7 lines.

„ 7 „ 9 „ 6 „
 „ 8 „ $8\frac{1}{2}$ „ 6 „

Obs. *Rh. nuciformis* was stated by *Sowerby* to be a globose shell, smaller than a hazel-nut, the edges of the plaits being rounded, and near the front often with a sunk line upon them (*loc. Farrington*); and although distinguished in England from other *Rhynchonellæ*, has, on the Continent, been very generally confounded with other forms. *M. D'Orbigny* places it as a synonym of *R. depressa* (*Sow. sp.*),¹ but from which it appears to differ by its general shape, which is transversely or oblongly oval, and at times almost circular, with its plaits often split near the front and margins, as is so well exemplified in the Palæozoic *Rh. Wilsoni* and other similar forms. While *R. depressa* (*Sow.*), as its name implies, is a depressed shell with imbricated plaits, this last character not having been observed in true *R. nuciformis*. Prof. *Bronn* commits another mistake, by considering the shell we are describing to be the same as *R. plicatilis*,² from which it appears removed by more than

¹ The author of the 'Pal. Franç.,' does not appear to have been acquainted with *Sowerby's R. nuciformis* and *depressa*, for his figure of this last ('Pal. Franç.,' vol. iv, pl. 491, figs. 1, 7), does not agree with any of the examples found in England.

² 'Index Pal.,' vol. ii, p. 1246.

one character, as may be easily perceived by comparing the figures or examples of the two species.

R. nuciformis is not very rare in the Upper Green Sand of Farringdon; it also occurs in the Chloritic Beds of Chardstock, where it has been collected by Mr. Wiest, &c.

Plate XI, figs. 23 and 24. Two typical examples from the Upper Green Sand of Farringdon (collection of Mr. Sharpe); fig. 23^{a b c}, are enlarged representations to show the character of the plaits.

„ fig. 25. A transverse and less gibbose specimen, from the same locality and collection.

„ figs. 26 and 27. Two other examples from Farringdon, in the cabinet of Mr. Lowe.

Plate XII, fig. 27. From the Upper Green Sand of Niton, Isle of Wight, in the collection of Mr. S. H. Saxby.

43. RHYNCHONELLA MARTINI, *Mantell*, Sp. Plate XII, figs. 15, 16.

TEREBRATULA MARTINI, *Mantell*. Geol. of Sussex, p. 131, 1822.

— PISUM, *Sowerby*. Min. Con., vol. vi, p. 70, tab. 536, figs. 6, 7, 1826.

— — *Fleming*. A Hist. of British Animals, vol. i, p. 374, 1828.

— — *Woodward*. A Synop. Table of British Org. Remains, p. 21, 1830.

— — *V. Buch*. Class. des Térébratules, Mém. de la Soc. Géol. de France, vol. iii, p. 148, pl. xv, fig. 18 bis, 1838.

— BREVIROSTRIS, *Ræmer*. Die Vers. Nord. Kreid., pl. vii, fig. 7, 1840.

— MARTINI, *Morris*. Catalogue, 1843.

RHYNCHONELLA PISUM, *D'Orb*. Prodrome, vol. ii, p. 171, 1850.

Diagnosis. Shell sub-orbicular, longer than wide, nearly square in front: valves almost equally convex, with the greatest depth at a short distance from the beaks, a slight longitudinal depression existing towards the front of either valve: no regular sinus nor mesial fold: margin nearly straight all round or slightly raised in front: beak short, acute, and moderately incurved, with a flattened space between the beak ridges and hinge line: foramen small, contiguous to the umbo, and entirely surrounded by a deltidium and its tubular prolongations: externally each valve is ornamented by from 30 to 40 delicate plaits, intersected by numerous concentric lines of growth. Length $4\frac{1}{2}$, width 4, depth $2\frac{1}{2}$ lines.

Obs. *R. Martini* is a small shell, never greatly exceeding the dimensions above stated, and more often not as large. The plaits are narrow, delicate, and augment here and there by intercalation: the numerous, closely packed, and slightly raised concentric lines of growth gives to the ridges of the plaits a granulated aspect, which is more deceptive than real.

This species was, for the first time, named and described by the celebrated author of

the 'Geology of Sussex,'¹ and although unfigured at that period, may be easily identified, being a shell well known to British geologists. In 1826 Sowerby figured and described the same species under the new appellation of *Terebratula pisum*, the same as had been given some years before by Mantell to a similar shell, mentioning Hamsey as his locality; and it seems singular that the greater number of subsequent authors preferred the Sowerby denomination, and it was only in 1843 that Mr. Morris, in his 'Catalogue,' reestablished Mantell's claims, by placing *T. pisum* as a synonym. *Ter. brevirostris* (Römer, 1840) has no better claims, being identical, both in shape and character with the Mantellian type. V. Buch adopts Sowerby's name, stating that the species does not appear to differ essentially from *R. octoplicata* of the same author! but this will require confirmation before being admitted, as the species seems to be little known to continental authors, he mentions several localities.

R. Martini abounds in the Chalk Marl and Grey Chalk of Hamsey and Folkstone, it has likewise been obtained from the "Chalk detritus" of Charing (Kent) by Mr. Harris; and some rare individuals have also been discovered in the Upper Green Sand of Horningsham, near Warminster, associated with another small species, which has since been termed *Rh. Grasiana* by M. d'Orbigny; the last-named shell seems to differ from the true *R. Martini* by its greater breadth and gibbosity, as well as by the frontal margin of the ventral valve greatly indenting that of the dorsal one. Mr. S. P. Woodward seems inclined to consider *R. Grasiana* as the adult state of *R. Martini* an opinion which may perhaps prove to be correct, but which I do not yet consider sufficiently demonstrated, from never observing among the numerous examples of *R. Martini*, found at Hamsey and Folkstone, specimens presenting the characters assigned to *R. Grasiana*: it may, therefore, for the present, be desirable to describe both separately; but if future observers should decide on the two being considered as one, then M. d'Orbigny's name will require to be placed as the synonym, on account of Mantell's priority, and it is but just to observe that, while proposing his name, *R. Grasiana*, the distinguished French Palæontologist did not omit to remark that, "*perhaps his species is the T. pisum of Sow., but which he was unable to affirm, on account of the differences which he remarks between his specimens and those figured by Sowerby*" ('Pal. Franc.' *Ter. Cret.*, vol. iv., p. 38); but, although fully admitting the difficulty, still specimens of the true *R. Martini*, perfectly agreeing with the figures published by Sowerby of *T. pisum*, occur in France, and have been collected more than once, both by M. Bouchard and myself, at Cap Blanc Nez, near Calais.

¹ Page 131, "*Ter. Martini*, subscrotiform, longitudinally striated, margin finely serrated; both valves slightly depressed in front, beaks very small. This is a minute and delicate species, scarcely 0·3 inch either in length or width; each valve is marked with upwards of 30 longitudinal striæ, and both equally convex. The margin is finely serrated by the terminations of the striæ, and is nearly straight in front, the sides are not waved, as in the last species (*T. sulcata*), named after W. Martin. Locality—Hamsey."

Plate XII, fig. 15. A typical example (fig. 15 *a*, *b*, enlarged) from the Grey Chalk in the vicinity of Folkstone, I avail myself of this occasion to thank Mr. Mackie for the opportunity he has kindly afforded me in the examination of an extensive series of this and other species from his locality.

„ fig. 16. A specimen from the Chalk Detritus of Charing (Kent), in the collection of Mr. Harris :—fig. 16^a is an enlarged illustration, to show how the plaits augment at times by intercalation ; this is, however, an extreme case, as in the generality of specimens the plaits appear more regular.

„ fig. 16^d. A specimen from the Upper Green Sand of Chute, near Warminster ; from the cabinet of Mr. Cunningham.

44. *RHYNCHONELLA GRASIANA*, *D'Orbigny*. Plate XII, figs. 17, 19.

RHYNCHONELLA GRASIANA, *D'Orbigny*. Pal. Franç., Ter. Crétacés, vol. iv, p. 497, figs. 7—11, 1847.

Diagnosis.—Shell transversely oval, somewhat obtusely five-sided ; slightly indented in front. Valves unequally convex, the *dorsal* or socket one commonly the deepest, without a produced prominent mesial fold. In the *ventral valve* a wide longitudinal sinus of moderate depth, extends from near the centre of the valve to the front, where the margin indents considerably that of the opposite valve ; beak short, acute ; foramen small, and entirely surrounded by the large tubular expansions of the deltidium ; a flattened space exists between the beak ridges and hinge line, which last slightly indents the lateral margins of the umbo. Externally each valve is ornamented by from 46 to 56 small plaits, at times augmented by the intercalation of smaller ones at various distances from the beak and umbo. Length 5, width 5, depth 3 lines.

Obs. We need not repeat the observations relative to this form noticed under *R. Martini* (Mantell) ; but it would appear that some French examples have attained larger dimensions than any hitherto obtained from our British localities ; thus a well formed specimen from the Basse Alpes (for which I am indebted to M. d'Orbigny), measures, length 7, width 7, depth 5 lines ; and I have seen a few even exceeding those measurements. The author of the 'Pal. Franc.' justly observes, that certain examples of this species somewhat resemble *R. Cuvieri* (D'Orb.) in their external contour, but may be distinguished by the greater number of plaits, position of the foramen, and less sinuous margins.

R. Grasiana abounds in the Upper Green Sand of Chute, near Warminster, in Ferruginous Beds of the same age near Clifton Hampden (Mr. Sharpe's collection), and in the Chloritic beds of Chardstock. In France, it is found in the Upper Green Sand near Havre (Seine Inf.), and in the neighbourhood of Grasse.

Shell ovately oblong, compressed; umbones small, mesial, compressed, rather pointed; shell with the sides anteriorly rounded, posteriorly compressed, truncated, and forming an obtuse angle, which slopes obliquely downwards to the infero-posterior extremity; the posterior side has some irregular longitudinal plications, which disappear towards the middle of the shell.

The Great Oolite variety of this species is many times smaller than that of the Inferior Oolite, and it is rather more elongated, but it presents no real specific difference. The test is delicate.

This shell was referred to Pullastra, by Professor Phillips, from its external form only, and we believe that only one or two specimens were at his disposal. The figure in the 'Geology of Yorkshire,' unaccompanied by any description, appears to have misled Professor Quenstedt, who has figured the hinge of *Tancredia donaciformis*, Lyc., for his exemplification of *Q. oblita*. The *Panopæa Lebrunæa*, Buvig. 'Paléont. de la Meuse,' Atlas, pl. 7, fig. 6, 7, is nearly allied to our species, but is more elongated and less truncated posteriorly. The arrangement of the longitudinal ridges is very similar.

Localities and position. *Quenstedtia oblita* has occurred in the Inferior Oolite of Blue Wick, Yorkshire, and in the upper portion of the same formation at Rodborough Hill, Cotteswolds. The shelly Great Oolite of Minchinhampton Common has afforded our smaller variety; but the species appears to be rare at each locality.

Dimensions. Our largest Inferior Oolite specimen has a length of $2\frac{1}{2}$ inches, and is $1\frac{2}{3}$ inch in height, the greater number of specimens being about 2 inches in length; but the Great Oolite variety is only 6 lines in length, and 3 in height.

CORBULA, Brug. 1791.

Shell ovately trigonal, convex, inequivalve, the left valve being the smaller; a single cardinal tooth in each valve projecting, that of the left valve being compressed; there is likewise a pit in each valve contiguous to the tooth, which is destined to receive the ligament; the ligament is internal, inserted in the pit of the right valve, and in the cavity of the tooth of the left valve; depression of the mantle posteriorly angulated.

CORBULA INVOLUTA, Goldf. Tab. IX, fig. 6.

CORBULA INVOLUTA, Goldfuss. Petref., t. 151, f. 14.

„ STRIATA, Buckman. Geol. of Cheltenham, 2d edit. p. 97, pl. 3, f. 4.

Testá parvâ convexâ, concentrice striatâ; umbonibus submedianis; latere postico rostrato, carinato, excavato; latere antico rotundato.

Shell small, convex, concentrically striated; umbones nearly mesial; posterior side rostrated and slightly excavated; anterior side rounded.

46. RHYNCHONELLA GIBBSIANA, *Sow.* Sp. Plate XII, figs. 11, 12.TEREBRATULA GIBBSIANA, *Sowerby*. Min. Con., vol. vi, p. 72, tab. 537, fig. 4, 1829.— GIBBSII, *Woodward*. A Synoptical Table of British Organic Remains, p. 21, 1830.— GIBBSIANA, *Morris*. Catalogue, 1843.

Diagnosis. Shell somewhat obtusely triangular, generally wider than long, with a moderately developed mesial fold in the *dorsal* valve, to which corresponds a sinus in the *ventral* one; beak acute, not much produced or incurved; foramen rather small, and surrounded by a deltidium; beak ridges sharply defined, with a flattened space between them and the hinge line, margins sinuous, the frontal edge of the ventral valve greatly indenting that of the opposite one. Each valve is exteriorly ornamented by from 45 to 50 small delicate plaits, 10 or 12 of these occupying the mesial fold and sinus. Dimensions variable, the greatest depth near the umbo; length $7\frac{1}{2}$, width 9, depth 5 lines;

,, 8 ,, 8, ,, $4\frac{1}{2}$,,

Obs. M. d'Orbigny considers this shell to be a variety of *R. sulcata*, but I do not feel prepared to admit that conclusion; *R. Gibbsiana* appears to me to be a much more triangular shell, with a deeper sinus, and externally ornamented by smaller or more delicate plaits; it seems peculiar to the *Lower Green Sand*, of Sandgate, Hythe, Pluckley, Peasmarsh, as well as at Sandown and Atherfield, Isle of Wight, (collection of Mr. S. Saxby). Some exceptional specimens found at Hythe bear resemblance to *R. latissima*, *Sow.*

The author of the 'Pal. Française,' moreover states, that the reference to this species published by Professor Forbes in his 'Catalogue of the Lower Green Sand Fossils' is incorrect; but on what grounds this assertion is made, I am at a loss to understand; it would, on the contrary, appear to me, that the French author had himself erroneously identified our British type, which he refers to his TERRAIN ALBIAN, which is not the age of our fossil in the vicinity of Folkstone, or other British localities.

Professor Bronn seems to be still further from the mark, while stating, in his 'Index Palæontologicus,' that *R. Gibbsiana* is nothing more than a variety or synonyme of *R. plicatilis*, *Sow.*!

Plate XII, fig. 11. A specimen from the *Lower Green Sand* of Sandown, Isle of Wight.

,, fig. 12. A rather enlarged example, from the *Lower Green Sand*, at Pluckley, in the collection of Mr. Harris.

,, fig. 12^c Another specimen, nat. size, from Hythe.

47. RHYNCHONELLA LINEOLATA, *Phillips*, Sp. Plate XII, figs. 6—10.TEREBRATULA LINEOLATA, *Phillips*. Geol. of Yorksh., vol. i, p. 178, pl. ii, fig. 27, 1835.— LINEOLATA, *Morris*. Catalogue, 1843.

TEREBRATULA SUBLINEARIS, Münster? MS. (Cambridge Museum.)¹

— LINEOLATA, Bronn. Index Pal., p. 1240, 1848.

— — D'Orbigny. Prodrome, vol. ii, p. 120, 1850.

Diagnosis. Shell ovate, more or less elongated; unequally convex and flattened; ventral valve commonly the deepest, with a slight and shallow longitudinal sinus; beak acute, moderately incurved; foramen small, circular, and surrounded by a deltidium. The dorsal valve is regularly convex to within a short distance of the front, where the surface exhibits either two or more plaits, with a mesial depression along the middle; externally, each valve is ornamented by numerous minute longitudinal striæ, which sometimes dichotomise near their extremities, or unite towards the front and lateral margins, forming a series of larger ribs; the lateral margins are but slightly flexuous, the frontal edge of the ventral valve indenting more or less that of the dorsal one.

Dimensions variable: length 8, width $7\frac{1}{2}$, depth 6 lines;

„ 4, „ 4, „ 3 „

Obs. This remarkable species was insufficiently figured and named (but not described) by Professor Phillips, from an unusually large example (Pl. XII, fig. 6,) obtained by Mr. Bean, in the Speeton Clay of Knapton, Yorkshire. The original type, still in the possession of Mr. Bean, was kindly forwarded for my examination, and I at once perceived that it belonged to the genus *Rhynchonella*; the external surface is entirely covered by delicate longitudinal striæ, 7 or 8 occupying the breadth of a line.

¹ Both Münster and Goldfuss have given many MS. names to species of Brachiopoda in the shape of catalogues, as well as to specimens in the Museum of Bonn; but these can claim no right to priority, never having been described nor figured, but in some cases having been adopted and referred to by Palæontologists. It may not prove devoid of interest to add some particulars kindly communicated by Dr. F. Rømer, of Bonn.

In a catalogue intitled *Verzeichniss der Versteinerungen welche in der Kreis-Naturalien-Sammlung zu Bayreuth Vorhanden sind Bayreuth im September, 1833*, 8vo, pp. 115, Count Münster names the following species, the majority of which are only MS. denominations:

- P. 44. *Ter. septemplicata*, from the Jurassic Limestone of Ebermannstadt.
- P. 45. *Ter. striato-plicata*, from the Jurassic Limestone of Streitberg.
- P. 46. *Ter. alaria*, from the ferruginous Oolite of Rabenstein and Thurnau.
- P. 47. *Ter. canaliculata*, from the Jurassic Limestone of Würgan.
- *Ter. pentaëdra*, from the Jurassic Limestone of Oberfellendorf.
- P. 48. *Ter. nana*, from the Jurassic Limestone of Streitberg.
- *Orbicula? dubia*, and *O.? semilunaris*, from Streitberg and Obermönchan.
- *Crania? paradoxa*, ibidem; *C.? pileus*, and *C. obscura*, Streitberg.
- P. 73. *Ter. pentagona, subovoides, angularis*,
- P. 74. *Ter. striato-plicata, semiplicata, subdecussata, quadrifida, Delthyris acuticosta*, } from the Lias of Franconia.
- *Del. speciosa*,
- P. 101. *Ter. Schlotheimii, sublata, subelongata*, from the Productus Limestone of Regnitzlosau.
- *Ter. coiculum*, from the Dev. Limestone of Elbersreuth.
- *Ter. gracilis, reflecta*, ibidem.
- P. 102. *Ter. subcrumena*, from the Dev. Rocks of Geroldsgrün.
- *Atrypa dubia, subcurvata*, from the Dev. Rocks near Hoff, in Franconia.
- *Atrypa glabra, A. rugosa*, from the Productus Limestone of Regnitzlosau.
- *Gypidia pelargonata*, ibidem.
- P. 103. *Delthyris alata, Lept. polymorpha*, from the Productus Limestone near Hoff.
- P. 104. *Lept. concentrica, aculeata, linearis, setosa, subrucosa, speluncaris*, from the Productus Limestone of Regnitzlosau.

GOLDFUSS added a long list of names of Brachiopoda (many of which can be only made out by com-

In the *Upper Green Sand* of Cambridge, a dwarf race of the same species has been plentifully collected by Mr. Carter, and appears to agree in all essential characters with the Speeton Clay specimen, except in dimensions. Mr. Carter considers the shell denominated *Ter. sublinearis*, by Count Münster, in the Cambridge Museum, to be specifically distinct from the one found in the Cambridge Upper Green Sand.

I collected the same shell in the *Tourtia*, near Tournay, in Belgium, it is exactly similar, but a little larger than those commonly met with at Cambridge; the last are also comparatively much more coarsely striated than the single example I have seen from Knapton, where the species would appear to be very rare.

Plate XII, fig. 6. The original type specimen from the Speeton Clay of Knapton.

„ fig. 6^{d e}. Are enlarged illustrations.

„ figs. 7, 8, 9. Specimens of a dwarf race from the *Upper Green Sand* of Cambridge, in the collection of Mr. Carter. These illustrations are enlarged, the vertical line indicates the natural size.

ARGIOPE.

In p. 16 of the present Monograph, will be found described as *Argiope decemcostata*, Roemer, Sp., a shell common to the Chalk of England, France, Belgium, Prussia, &c.; but after the publication of the first portion of this monograph, I was informed by M. de Hagenow, that he still doubted the shells I had figured (Pl. III, figs. 1, 13), as

paring the originals in the Museum of Bonn), in the *Handbuch der Geognosie*, von H. T. de la Beche: *nach der zweiten Auslage des Englischen originals bearbeitet*, von H. von Dechen, Berlin, 1832. These are:

- P. 382. *Ter. impressa*, from the white Jurassic Marls at Hohenzollern, Stufenberg Urach.
- P. 523. *Lept. convoluta, furcata, capillata, minuta*, from the Dev. Limestone of the Eifel.
- *Lept. striata, pectinata*, from the Dev. Greywacke of Coblenz.
- *Lept. loevis*, from the Carb. Limestone of Visé.
- P. 524. *Lept. corrugata, considea*, ibidem.
- P. 525. *Orthis radiata*, Eifel; *O. costata*, Kentucky; *O. granulosa*, Catskill Mountains; *O. fasciculata*, Eifel; *O. nodosa*, Eifel; *O. undulata*, Albany.
- *Delthyris microptera*, Eifel, Gloucestershire, Herefordshire; *D. compressa* (*D. triangularis*, Sow.), Bansberg, Derbyshire; *D. heteroclyta* (*Calceola heteroclyta*, Def.), Eifel; *D. macroptera*, Eifel, Catskill Mountains.
- P. 526. *Delt. ceptoptera*, Eifel; *D. pachyoptera*, N. York; *D. dorsata*, Straberg; *D. bisulcata*, Visé; *D. canalifera* (*Ter. aperturata*, Schl.; *T. canalifera*, Sow.), Bensberg; *D. canaliculata*, Bensberg; *D. polymorpha*, Ratingen; *D. incisa*, Ratingen, Moskau; *D. symmetrica*, England; *D. curvata* (*Ter. curvatus*, Schl.), Eifel; *D. biplicata*, *D. radiata*, *D. thecaria*, Ratingen; *D. striatula* (*Ter. striatulus*, Schl.), Eifel.
- P. 527. *D. vestita* (*Ter. vestitas*, Schl.), Ratingen; *D. concentrica*, ibid.; *D. imbricata* (*T. imbricata*, Sow.) ibid.; *Gypidia gryphoides* (*Uncites Gryphus*, Def.), Paffrath; *G. loevis*, ibid.; *Strigocephalus striatus*, Eifel; *Atrypa nitida*, Lake Simcoe.
- P. 528. *Ter. triloba*, *T. canaliculata*, *T. quinquelatera*, *T. dichotoma*, *T. pentagona*, *T. Wahlembergii*, *T. subglobosa*, *T. bifida*, *T. clavata*, from the Eifel; *Ter. Dalmanni*, Carb. Limestone of Ratingen; *T. Anygdale*, Eifel; *T. complicata*, Dev. Rocks of Irelohn.

The only Brachiopoda described and figured by Goldfuss are those published in his great work, 'Petrefacta Germaniæ.'

belonging to the Essen species; that they were identical with those he had published in 1842, under the names of *Orthis (Argiope) Bronnii* and *O. (Argiope) Buchii*. This view may probably prove correct, and I may have been led into error from having placed too much value on the fact, that many individuals of the Chalk species possess ten costæ, and thus so far agreeing with Rømer's Green Sand species. In 1852, I was acquainted with no other British species or specimens of *Argiope* lower down than the Soft or Upper Chalk, but since that period, I have been able to examine several others from the *Lower Chalk* of Kent and *Upper Green Sands* of Warminster and Cambridge. It will therefore be desirable to reconsider our British Cretaceous Argiopes.

48. ARGIOPE MEGATREMA, Sowerby, Sp. Plate XII, figs. 31—32, and 34—36.

TEREBRATULA MEGATREMA, Sowerby, in *Fitton*. Trans. Geol. Soc., vol. iv, 2d series, p. 343, pl. xviii, fig. 3 (read in 1827, printed in 1836.)

— — — *Morris*. Catalogue, 1836.

— DECEMCOSTATA, Rømer. Vers. Nord. Kreid, p. 41, tab. 13, 1840.

— MEGATREMA, Bronn. Index Pal., p. 1241, 1848.

— — — *D'Orbigny*. Prodrome, vol. ii, p. 172, 1850.

— — — A Cat. of the Terebratulæ in the British Museum, p. 56, 1853.

— DECEMCOSTATA, Dr. Fr. Rømer. Die Kreid, Westphalans, p. 71, 1854.

Diagnosis. Shell transversely obovate, or obtusely pentagonal; valves almost equally and moderately convex, deepest near the umbo; beak produced, nearly straight, truncated by an oblique and large foramen; beak ridges defined, leaving between them and the hinge line a more or less developed triangular area; hinge line as long or shorter than the greatest width of the shell. The external surface of each valve is ornamented by from ten to twelve ribs, with flattened interspaces between. The costæ correspond in each valve, a few smaller ones being intercalated between the larger ones near the frontal margin. In the interior of the *dorsal valve*, the loop first fixed to the base of the dental sockets is folded into two lobes, and attached to a single mesial plate.¹ Length $2\frac{1}{2}$, width 3, depth $1\frac{1}{2}$ lines.

Obs. So rare is this little shell, that for many years I was unable to trace a single example; and it was only during a recent visit to the Bristol Institution Museum, that I had the good fortune to discover in that collection one example, which proved, on examination, to agree with the shell described and figured by Sowerby, in the 'Geological Transactions': it is a true *Argiope*, not a *Terebratula*, as generally supposed. Rømer's figure of *A. decemcostata*, Pl. XII., fig. 35, and another, fig. 36, furnished by M. de Hagenow, might at first sight indicate a distinct species on account of the length of the hinge line and area, but having recently received from Dr. Fr. Rømer a specimen collected

¹ The interior of this species has been admirably described and figured by M. Suess, in his excellent memoir entitled 'Ueber die Brachial-Vorrichtung bei den Thecideen,' pl. iii, fig. 1 (Aus dem Decemberhefte des Jahrganges, 1853) der Sitzungsberichte der mathem-naturw. Classe der kais Akademie der Wissenschaften (xi Bd., s. 991), besonders abgedruckt.

by himself at Essen, I became convinced that this long hinge line was exceptional, and that the true characters of the species are similar to those assumed by *A. megatrema*, Sow., or intermediate between figs. 32 and 34, five or six examples of the last having been discovered by Mr. Carter in the Upper Green Sand near Cambridge.

Plate XII, fig. 31. The original figure of *Terebratula Megatrema*, Sowerby, from the 'Geological Trans.,'¹ vol. x.—Fig. 31^a. An enlarged illustration.

„ fig. 32. A specimen from the Upper Green Sand of Warminster, in the Bristol Institution Museum.—Fig. 32^{a b}. Enlarged figures.

„ fig. 34. A British example, from the Upper Green Sand of Cambridge, in the collection of Mr. Carter.—34^{a b c}, enlarged. This specimen shows the intercalated ribs.

„ fig. 35. Roemer's published figure of *Ter. decemcostata* considerably enlarged, from the Green Sand of Essex, and introduced here to facilitate comparison.

„ fig. 36. Another example from the same locality, drawn by M. de Hagenow.—36^a, enlarged illustration.

ARGIOPE BRONNII, *De Hagenow*, Sp. Plate III, figs. 1—13, and Plate XII, figs. 37, 38.

(Described as ARGIOPE DECEMCOSTATA, *Römer*, in p. 16 of the present Monograph.)

ORTHIS BRONNII, *V. Hag.* Neu. Jahrb. F. Mineral, pl. ix, fig. 7, 1842.

— BUCHII, *V. Hag.* Ib., pl. ix, fig. 8, 1842.

TEREBRATULA DUVALII, *Dav.* London Geol. Journal, p. 113, pl. xviii, figs. 15—18, 1847.

MÉGATHYRIS CUNEIFORMIS, *D'Orb.* Pal. Franç., Ter. Crétacés, vol. iv, p. 147, pl. 521, figs. 1—11, 1847.

Having already fully described this species, I will simply remark that it is found in the Upper Chalk of Northfleet, Gravesend, Meudon (France), and in Prussia. It possesses in general fewer ribs than the Upper Green Sand species, and its dorsal valve is likewise less convex. M. de Hagenow having kindly presented me with specimens of both his *A. Bronnii* and *A. Buchii*, I was able to convince myself that they belong to a single species, identical in shape and character with those found in England and France; and to facilitate comparisons, I have reproduced, in Plate XII, the original published figures of M. de Hagenow's two species.

Plate XII, fig. 33. Illustrates the only specimen of *Argiope* hitherto discovered in the Lower Chalk of Kent (British Museum).

„ fig. 33^a. A magnified illustration of the same.

¹ Sowerby describes his species, as follows:—*Ter. megatrema*: moderately convex, transversely obovate, with a few distinct ribs. The beak is large and produced with a very large perforation, whence the name.

49. CRANIA CENOMANENSIS, *D'Orbigny*. Plate XII, figs. 40, 41.

CRANIA CENOMANENSIS, *D'Orbigny*. Pal. Franç., Ter. Crétacés, vol. iv, p. 138, pl. 524, figs. 1—4, 1847.

— — — *Sharpe*. Quart. Journ. of the Geol. Soc., vol. x, p. 193, 1853.

Diagnosis. Shell unsymmetrical, transversely oval: *lower* or *ventral* valve thick, and almost flat, attached to marine objects by a large portion of its external surface; interiorly a raised margin surrounds the shell, four principal muscular impressions occupy the posterior half of the inner disk, the posterior adductor pair are large and oval, slightly produced, and placed obliquely close to each other and to the cardinal edge. The anterior adductor impressions are almost approximate at their base, and situated close to the centre of the shell, with their outer extremities directed upwards, so that a lozenge-shaped depression remains between the four large impressions above described; towards the centre of the shell there likewise exists a small elongated projection, the remaining portion of the inner disk exhibiting distinct imprints of the vascular system. The *dorsal* or upper valve is thin, conical, or patelliform; the vertex sub-central, rough externally. The interior is deep, with a thin concave border, which fits upon and over the raised margin of the opposite valve, a small inner ridge surrounds the shell at a short distance from the edge. The posterior adductor scars are oval and widely separate; the anterior pair are placed near the centre of the valve, and in contact at their base, with their outer extremities directed upwards and towards the cardinal angles of the valve.

Dimensions variable: length 4, width 5;

„ $4\frac{1}{2}$, „ 7, height 2 lines.

Obs. The only British specimens of this species I have been able to examine were discovered by Mr. Sharpe in the Upper Green Sand or gravel, of Farringdon, and belong to one upper and lower valve of two different individuals. The ventral valve (Pl. XII, fig. 40) is very flat, with a sercula covering a portion of its outer surface, and this is likewise the first example of the attached valve hitherto discovered, M. d'Orbigny being only acquainted with the dorsal one (Pl. XII, fig. 41), with which Mr. Sharpe's specimen perfectly agrees; I must, therefore, dissent with the last-named gentleman, who considers his upper valve to belong perhaps to the large chalk *Crania*, found at Ciply, in Belgium, termed *C. Parisiensis* by Mr. Sharpe,¹ but which appears to me specifically distinct from the species which bears that name.

Plate XII, fig. 40. *Lower valve* from Farringdon, in the collection of Mr. Sharpe.

„ fig. 40^a. Enlarged illustration.

„ fig. 41. *Upper valve* from the same locality and collection; 41^a, enlarged.

¹ Quart. Journal Geol. Soc., vol. x, p. 192, 30th Nov., 1853.

TABLE ILLUSTRATING THE GEOLOGICAL DISTRIBUTION OF THE
BRITISH CRETACEOUS BRACHIOPODA.

Genus or Sub-genus. Species.	Author.	Date.	Reference to the Plates and Figures in this Monograph. (Part II.)								
				Lower Green Sand.	Speeton Clay.	Gault.	Red Chalk.	Upper Green Sand.	Farringdon Sponge Gravel.	Chlor. Marl or Chalk with Silic. grains.	Lower Chalk or Chalk Marl.
<i>Lingula truncata</i> . . .	Sowerby	1827	pl. i, figs. 27, 28, and 31	*							
„ <i>sub-ovalis</i> ¹ . . .	Davidson	1852	pl. i, figs. 29, 30 . . .					*			
<i>Crania Parisiensis</i> . . .	Defrance	1819	pl. i, figs. 1—7 . . .								*
„ <i>Ignabergensis</i> ² . . .	Retzius	1781	pl. i, figs. 8—14 . . .								*
„ <i>cenomanensis</i> . . .	D'Orbigny	1847	pl. xii, figs. 40—41 . . .					*			*
<i>Thecidium Wetherellii</i> ³ . . .	Morris	1851	pl. i, figs. 15—26; & pl. xii, fig. 39 . . .					*			*
<i>Argiope megatrema</i> . . .	Sowerby	1836	pl. xii, figs. 31—36 . . .					*		?	*
„ <i>Bronnii</i> ⁴ . . .	De Hagenow	1842	pl. iii, figs. 1—13; & pl. xii, figs. 37, 38 . . .							?	*
<i>Magas pumila</i> . . .	Sowerby	1816	pl. ii, figs. 1—10 and 23 ?								*
<i>Terebratella Menardi</i> ⁵ . . .	Lamarck	1819	pl. iii, figs. 34—42 . . .					*			*
„ <i>pectita</i> . . .	Sowerby	1818	pl. iii, figs. 29—33 . . .					*			*
<i>Trigonosemus elegans</i> . . .	Koenig	1825	pl. iv, figs. 1—4 . . .								*
„ <i>incertum</i> ⁶ . . .	Davidson	1852	pl. iv, fig. 5 . . .						*		*
<i>Terebrirostra lyra</i> . . .	Sowerby	1818	pl. iii, figs. 17—28 . . .					*			*
<i>Megerlia lima</i> ⁷ . . .	Defrance	1828	pl. iv, figs. 15—28; and pl. v, figs. 1—4 . . .					*		*	*
<i>Terebratulina striata</i> . . .	Wahlenberg	1821	pl. ii, figs. 18—28 . . .		*	?		*		*	*
„ <i>gracilis</i> , and <i>var. rigida</i> . . .	Schlotheim	1813	pl. ii, figs. 13—16 . . .			*	?	*		*	*
„ <i>capitata</i> ⁸ . . .	Sowerby	1829	pl. ii, fig. 17 . . .			*		*		*	*
<i>Terebratula? capitata</i> ⁸ . . .	D'Archiac	1847	pl. v, fig. 12 . . .				*				*

¹ This species has been found by Mr. S. H. Saxby, in the Blue Rag of the Upper Green Sand series, at Bonchurch (Isle of Wight).

² Erroneously spelt Egnabergensis, in p. 11. This is *Numulus minor* of Stobæus, 1732.

³ Several ventral or attached valves of a *Thecidium*, considered to belong to *T. Wetherelli* (Pl. XII, fig. 39), have been collected by Messrs. Sharpe, Wright, Morris, and myself, in the Sponge Gravel of Farringdon. They have been found adhering to valves of *Ter. depressa* (Lamarck), to the *Actinopora papyracea*, *Manon Farringtonensis*, &c. Specimens with both valves are found in the Chalk of Brighton.

⁴ This shell has (according to M. De Hagenow) been erroneously described and figured in this Monograph, under the name of *Arg. decemcostata* (p. 16, and Pl. III, figs. 1—13), but corrected again in p. 102. Although I do not yet consider the question finally settled.

⁵ Several examples of this shell have been found by Mr. Wiest, in the Chloritic bed of Chardstock, along with *T. pectita*; the last-named species has likewise been found by Mr. S. H. Saxby, in the *Chloritic Marl* of the Isle of Wight.

⁶ In 1852, only one example was known, but since that period several others have been discovered in the neighbourhood of Chardstock, by Mr. Wiest.

⁷ In p. 40, I proposed to establish a *Sub-genus* KINGINA for the reception of this and other similarly organised forms, based upon certain modifications, in the shape and attachment of the apophysary skeleton or loop; but from its having been subsequently observed that these differences were not essentially distinct from what we find in Professor King's sub-genus *Megerlia*, I am ready to abandon my former view, as it is always incumbent to simplify the nomenclature, when it can be achieved without serious effects.

⁸ M. De Koninck has informed me, that this species was named *Spondylus undulatus*, by Geinitz, in 1839, and figured in the 'Die Vers., von Kieslingswalda,' pl. vi, fig. 8, 1843. I have seen the original example, now at Liege, in M. De Koninck's collection, and it is certainly the same shell as subsequently described by the name of *T. capitata*, by Viscount D'Archiac.

Genus or Sub-genus.	Species.	Author.	Date.	Reference to the Plates and Figures in this Monograph. (Part II.)	Lower Green Sand.	Speeton Clay.	Gault.	Red Chalk.	Upper Green Sand	Faringdon Sponge Gravel.	Chlor. Marl or Chalk with Silic. grains.	Lower Chalk or Chalk Marl.	Chalk.
<i>Terebratula</i> ?	<i>ovata</i> . . .	Sowerby	1812	pl. iv, figs. 6—13 . . .	..	..	..	..	..	..	..	..	..
„	? <i>rugulosa</i> . . .	Morris	1847	pl. iv, fig. 14 . . .	..	..	..	..	..	..	..	..	..
„	? <i>squamosa</i> . . .	Mantell	1822	pl. v, figs. 5—11 . . .	..	..	..	..	..	..	..	..	..
„	? <i>oblonga</i> . . .	Sowerby	1826	pl. ii, figs. 29—32 . . .	..	..	..	..	..	..	..	..	..
„	<i>obesa</i> . . .	Sowerby	1823	pl. v, figs. 13—16 . . .	..	..	..	..	..	..	..	..	..
„	<i>biplicata</i> . . .	Brocchi	1814	pl. vi, figs. 1—49; and pl. ix, figs. 37 and 40 ?	?	..	..	..	..	..	..	..	..
„	<i>prælonga</i> . . .	Sowerby	1836	pl. vii, figs. 1, 2 . . .	..	..	..	..	..	..	..	..	..
„	<i>sella</i> . . .	Sowerby	1823	pl. vii, figs. 4—10 . . .	..	..	..	..	..	..	..	..	..
„	<i>Tornacensis</i> ? <i>var.</i> <i>Roemeri</i> . . .	D'Archiac	1847	pl. vii, figs. 11—16; and pl. ix, figs. 1—8 . . .	..	..	..	..	..	..	..	..	..
„	<i>sulcifera</i> . . .	Morris	1847	pl. vii, figs. 17—20 . . .	..	..	..	..	..	..	..	..	..
„	<i>semiglobosa</i> and varieties . . .	Sowerby	1812	pl. viii, figs. 6—18 . . .	..	..	..	..	..	..	..	..	..
„	<i>carnea</i> . . .	Sowerby	1812	pl. viii, figs. 1—5 . . .	..	..	..	..	..	..	..	..	..
„	<i>Robertoni</i> . . .	D'Archiac	1847	pl. ix, fig. 25 . . .	..	..	..	..	..	..	..	..	..
„	<i>depressa</i> . . .	Lamarck	1819	pl. ix, figs. 9—24 . . .	..	..	..	..	..	..	..	..	..
„	<i>Carteri</i> . . .	Davidson	1854	pl. vii, fig. 3 . . .	..	..	..	..	..	..	..	..	..
<i>Waldheimea</i>	<i>celtica</i> . . .	Morris	1853	pl. ix, figs. 32—35 . . .	..	..	..	..	..	..	..	..	..
„	<i>tamarindus</i> . . .	Sowerby	1836	pl. ix, figs. 26—31 . . .	..	..	..	..	..	..	..	..	..
<i>Rhynchonella</i>	<i>plicatilis</i> . . .	Sowerby	1818	pl. x, figs. 37—42 . . .	..	..	..	..	..	..	..	..	..
„	<i>var. octoplicata</i> . . .	Sowerby	1818	pl. x, figs. 1—17 . . .	..	..	..	..	..	..	..	..	..
„	<i>var. Woodwardii</i> . . .	Davidson	1854	pl. x, figs. 43—46 . . .	..	..	..	..	..	..	..	..	..
„	<i>limbata</i> ¹ . . .	Schlotheim	1813	pl. xii, figs. 1—5 . . .	..	..	..	..	..	..	..	..	..
„	<i>compressa</i> . . .	Lamarck	1819	pl. xi, figs. 1—5; and pl. xii, fig. 25 . . .	..	..	..	..	..	..	..	..	..
„	<i>latissima</i> . . .	Sowerby	1825	pl. xi, figs. 6—22; and pl. xii, fig. 24 . . .	..	..	..	..	..	..	..	..	..
„	<i>depressa</i> . . .	Sowerby	1825	pl. xi, figs. 28—32; and pl. xii, fig. 26 . . .	..	..	..	..	..	..	..	..	..
„	<i>var. A</i> . . .	Davidson	—	pl. xii, fig. 30 . . .	..	..	..	..	..	..	..	..	..
„	<i>var. B</i> . . .	Davidson	—	pl. xii, fig. 28 . . .	..	..	..	..	..	..	..	..	..
„	<i>sulcata</i> . . .	Parkinson	1811	pl. x, figs. 18—36 . . .	..	..	..	..	..	..	..	..	..
„	<i>Mantelliana</i> . . .	Sowerby	1826	pl. xii, figs. 20—23 . . .	..	..	..	..	..	..	..	..	..
„	<i>Cuvieri</i> . . .	D'Orbigny	1847	pl. x, figs. 50—54 . . .	..	..	..	..	..	..	..	..	..
„	<i>nuciformis</i> . . .	Sowerby	1825	pl. xi, figs. 23—27 . . .	..	..	..	..	..	..	..	..	..
„	<i>Martini</i> . . .	Mantell	1822	pl. xii, figs. 14—16 . . .	..	..	..	..	..	..	..	..	..
„	<i>Grasiana</i> . . .	D'Orbigny	1847	pl. xii, figs. 17—19 . . .	..	..	..	..	..	..	..	..	..
„	<i>parvirostris</i> . . .	Sowerby	1836	pl. xii, figs. 13, 14 . . .	..	..	..	..	..	..	..	..	..
„	<i>Gibbsiana</i> . . .	Sowerby	1826	pl. xii, figs. 11, 12 . . .	..	..	..	..	..	..	..	..	..
„	<i>lineolata</i> . . .	Phillips	1836	pl. xii, fig. 6 . . .	..	..	..	..	..	..	..	..	..
„	<i>var.</i> . . .	—	—	pl. xii, figs. 7—10 . . .	..	..	..	..	..	..	..	..	..

¹ This is the *sub-plicata* of Mantell, and it may still remain a question whether it should not merely constitute a *var.* of *R. plicatilis* or *octoplicata*, Sowerby.

SUPPLEMENTARY OBSERVATIONS ON THE STRATIGRAPHICAL DISTRIBUTION OF THE SPECIES.

The general results in the present Monograph differ from those published by several distinguished contemporaneous authors; it will therefore be necessary to explain the cause of this apparent difference of opinion.

The most recent Catalogue of *British Cretaceous Brachiopoda*, is that published in 1847, by Mr. Tennant,¹ in which forty-nine specific names have been enumerated; but a critical examination has led me to place about twenty² of these, either among the synonyms of species already mentioned, or as hitherto undiscovered in Great Britain; so that the entire list published by the above-mentioned author would not exceed some *thirty species*.

It has been stated in the fifth volume of the 'Histoire des Progrès de la Géologie' (p. 109, 1851), that fifty-two species of Brachiopoda have been recorded as existing in *British Cretaceous Strata*: the learned author mentioning at the same time that his results and identifications are chiefly based on those already published in Mr. Morris's 'Catalogue of British Fossils' (1843).

¹ 'A Stratigraphical List of British Fossils,' p. 47, 1847. In January, 1854 (the period at which my Table had been completed, see 'Bull. Soc. Geol. de France,' vol. xi), the new edition of Mr. Morris's 'Catalogue' had not appeared.

² These are:

- | | |
|---|--|
| 1. <i>Crania ovalis</i> , Woodward = <i>C. Ignabergensis</i> , Retzius. | 13. <i>Terebratula elongata</i> , Sowerby = <i>T. carnea</i> , Sow. |
| 2. „ <i>spinulosa</i> , Neilsson (not hitherto found in England). | 14. „ <i>faba</i> , Sowerby = (dwarf) <i>T. biplacata</i> , Brocchi. |
| 3. „ <i>striata</i> , Sowerby = <i>C. Ignabergensis</i> . | 15. „ <i>obliqua</i> , Sowerby (not Cretaceous). |
| 4. <i>Lingula ovalis</i> (a Jurassic shell). | 16. „ <i>octoplicata</i> , Sowerby = var. of <i>R. plicatilis</i> , Sowerby. |
| 5. <i>Orbicula lævigata</i> , Deshayes (not a Brachiopod). | 17. „ <i>pentagonalis</i> , Phillips = var. of <i>T. striata</i> , Wahl.? |
| 6. <i>Terebratula brachyrostris</i> , Roemer = <i>Rhynchonella Martini</i> , Mantell. | 18. „ <i>quadrata</i> , Sowerby = <i>T. oblonga</i> , Sowerby. |
| 7. <i>Magas truncata</i> , Sowerby = var. of <i>M. pumila</i> , Sowerby. | 19. „ <i>rigida</i> , Sowerby = var. of <i>T. gracilis</i> , Schlotheim. |
| 8. <i>Terebratula cryalis</i> , Schlotheim — young of <i>T. striata</i> , Wahlenberg. | 20. „ <i>rostrata</i> , Sow. (a Jurassic shell). |
| 9. „ <i>convexa</i> , Sowerby = <i>R. (lata or) latissima</i> , Sowerby. | 21. „ <i>striatula</i> , Mantell = <i>Ter. striata</i> , Wahlenberg. |
| 10. „ <i>dilatata</i> , Sowerby = <i>R. compressa</i> , (var.) Lamarck. | 22. „ <i>subrotunda</i> , Sowerby = var. of <i>T. semiglobosa</i> , Sow. |
| 11. „ <i>dimidiata</i> , Sowerby = <i>R. compressa</i> , (var.) Lamarck. | 23. „ <i>subundata</i> , Sowerby = var. of <i>T. semiglobosa</i> , Sow. |
| 12. „ <i>elegans</i> , Sowerby = <i>R. latissima</i> , Sowerby. | |

Viscount d'Archiac has accordingly presented us with the following Table :

Distribution of the Class according to Viscount d'Archiac.	Number of the Genera.	Number of the Species.	Upper Chalk (<i>Craie Blanche</i>).	Lower Chalk and Chalk Marl (<i>Craie Tuffeau</i>).	Upper Green Sand.	Gault.	Lower Green Sand.	Green Sand of Devonshire.	Species common to the Upper Chalk and to the Chalk Marl.	Species common to the Upper Chalk and to the Upper Green Sand.	Species common to the Chalk Marl and to the Upper Green Sand.	Species common to the Upper Green Sand and to the Gault.	Species common to the Gault and Lower Green Sand.	Species common to the Upper Green Sand to the Gault, and to the Lower Green Sand.	Species common to the Upper Green Sand and to the Lower Green Sand.
BRACHIOPODA . .	5	52	18	11	10	5	22	5	5	—	2	—	1	2	3
And I now place into corresponding Columns the results arrived at during the publication of the present Monograph.															
According to Mr. Davidson.	Genera or Sub-Gen.														
BRACHIOPODA . .	13	about 49	14 or 15	15	28 or 30	7 or 8	8	—	7	6	8	6	1	2	2 or 3

Although fifty-two species are recorded in the French author's table, and only forty-nine in our own, still in reality the last number greatly exceeds that presented by the Viscount, because, at least twenty-two to twenty-four of his names are synonyms, while my list contains a number of species new to England, and mentioned in no other publication. But I must at the same time hasten to announce, that notwithstanding all the care, researches, and consultations undertaken in the identifications of the species, I have not always arrived at results which can be considered finite, and possibly forty-five good species may comprise all that have been hitherto discovered in *British Cretaceous Strata*.

Much additional investigation will likewise be required before the exact stratigraphical repartition of certain forms can be definitely established; and to arrive at this most important geological desideratum, it will be necessary to settle in a definite manner the *comparative age* of certain beds above the Gault in the Isle of Wight, at Cambridge, Farringdon, Chardstock, and in a few other localities.

Thus, according to the generality of British geologists, the *Farringdon Sponge Gravel* would belong to the age of the *Lower Green Sand*; by myself, to that of the *Upper Green Sand* or *Tourtia*:¹ and by Mr. Sharpe, more modern than the Chalk, or in other words, to the *Upper Maestricht (Cretaceous) beds* and Pisolitic Limestone of Laversine (France).

¹ See 'Bull. de la Soc. Geol. de France,' vol. xi, Feb. 1854. I believe this view is likewise sanctioned by Mr. S. P. Woodward.

And as the stratum in question contains some twelve or more species of Brachiopoda, by casting these into one or other deposit, the number of forms peculiar to each is necessarily materially modified. This will in great measure explain why in my table only eight species are recorded from the *Lower Green Sand*, while there would exist twenty-two, according to Viscount D'Archiac and others.

I mentioned in 1852 (page 2 of this Monograph), "*that the age of the Farrington beds may yet afford a subject of discussion, although several geologists state them to be Lower Green Sand.*" Since then, Mr. Sharpe has renounced his share in the views entertained by Messrs. Austen, Forbes, and others,¹ and has lately published a very interesting memoir,² wherein he exposes his present opinion, which is chiefly founded upon the examination of 111 species he had been able to assemble from that celebrated locality. But as these results are not in accordance with those of other geologists, and differ likewise with my own, I will endeavour in a few short observations to explain wherein we disagree.

Mr. Sharpe records his palæontological inferences in the following table :

	Sponges.	Bryozoa.	Brachiopoda.	Lamelli-branchiata.	Echinodermata.	Sundries.	Total.
Species peculiar to the deposit	4	1	1?	3	4	1	14
Maestricht Sands	2	3	4	3	—	—	12
Upper Chalk	1	20	3	5	—	3	32
Lower Chalk	1?	2	3	2	—	4	12
Upper Green Sand, including Tourtia	11	17	11	—	—	3	50
Gault	—	1	1?	2	—	1	5
Lower Green Sand ³	—	4	2	3	3	1	13
Total number of Species examined	16	44	19	18	7	7	111

¹ Quarterly Journal of the Geol. Soc., vol. vi, p. 454, 1850.

² Ib., vol. x, p. 176, Nov., 1853.

³ Mr. Sharpe mentions the following Lower Green Sand species as occurring in the Farrington Gravels :

"*Reptomulticava micropora*.

„ *collis*, also found in the White Chalk.

"*Heteropora cryptopora*, also found in the Maestricht Sand.

"*Proboscina marginata*.

"*Terebratula tamarindus*.

„ *oblonga*, also found in the Upper Green Sand.

"*Ostrea macroptera*, also in the Gault and Upper Green Sand, and perhaps in the Chalk.

"*Pecten Dutemplii*, also in the Upper Green Sand.

"*Pecten interstriatus*, perhaps identical with *P. Dutemplii*.

"*Serpula quinque-angulata*.

And further observes, "that the examination of the whole list of species, or that of the families separately, gives the results, that the Farringdon Gravels contain species hitherto thought characteristic of every bed, from the Lower Green Sand to the Maestricht Sand inclusive; but that those referable to species found elsewhere, above the Gault, predominate nearly ten to one in the number of species, and still more so in that of individuals; so that we need only consider to what part of the Cretaceous series above the Gault this deposit belongs.

"This conclusion limits our choice to the *Upper Green Sand*, or to a place altogether above the *Chalk*; for no one could seriously propose to place it on a level with the *Chalk*. That nowhere is there any trace of gravel nor any ferruginous bed in the *Upper Green Sand* of this part of England. Very few of the organic remains of Farringdon which are referable to the *Upper Green Sand* are found in that deposit in this neighbourhood; Warminster being the nearest spot which affords any large numbers of these species, and then only in the uppermost bed of the formation; but for the counterparts of the greater number we must travel to the *Tourtia* of Belgium, or to *Essen* in *Westphalia*.¹ That it might lead to erroneous results if we drew our conclusions from the *Bryozoa*, their geological range in this country being little known, but the remaining classes furnish safe grounds of comparison: of these, the Farringdon Gravel contains thirty-three species, found either in the *Upper Green Sand*, the *Tourtia*, or in the *Craie Chloritée* of France; but of these thirty-three species, only thirteen are known in the *Upper Green Sand* of England, and most of them range upwards into higher strata." The author concludes "that we are driven step by step, by the exhaustion of all other alternatives, to class the Farringdon Sponge Gravel as more modern than the *Chalk* (but not in the *Tertiaries*); other relics of the *Upper Cretaceous* deposits being found in the *Limestones* of *Faxoe*, the *Calcareous Sands* and *Sandstones* of *Maestricht*, *Ciply*, and the *Pisolitic Limestones* of *Laversine* and *Vigny*."

The attentive examination of Mr. Sharpe's table of species will, in my humble opinion,

"*Salenia punctata*, of Atherfield.

"*Goniopygus peltatus*, of Switzerland.

"*Diadem dubium*, ,,

Besides these, I picked up in the locality, an Urchin, which Dr. Wright states to be unquestionably the *Nucleolites Neocomiensis*, Ag. It is a little larger than the type specimens, and much larger than the French ones; but its characters are so well marked, that it cannot be mistaken.

Several Oolitic Fossils have been long since detected in the Farringdon Gravel Beds, but which Mr. Sharpe justly regards as strangers brought in the fossil state to the locality. There are *Coral Rag* and *Kimmeridge Clay* Fossils, over which the Farringdon Gravel appears to extend.

¹ In the fourth volume of the new edition of Bronn's '*Lethea. Geog.*,' p. 25, &c., the *Green Sand* of *Essen* is considered to be parallel to the *Tourtia* and *Chalk Marl?* of *Sussex*. See also Dr. Fr. Roemer, *Memoir, die Kreid Westphalens*, 1854. Wherein the following *Brachiopoda* are mentioned, several of which are common to our English *Upper Green Sand* under other names: *Thecidea digitata*, Bronn.; *Th. hippo-crepis*, Goldf.; *Th. hieroglyphica*, Goldf.; *Ter. gallina*, Brong.; *T. latissima*, Sow.; *T. paucicosta*, Roemer; *T. nuciformis*, Sow.; *T. Beaumonti*, d'Arch.; *T. auriculata*, R.; *T. radians*, R.; *T. nerviensis*, d'Archiac; *T. Tornacensis*, d'Arch.; *T. pectoralis*, R.; *T. arcuata*, R.; *T. canaliculata*, R.; *T. decemcostata*, R.

go far to bias many in favour of the view here taken, viz., that the *Farringdon Sponge Sand* and *Gravel* has greater claims to the age of the *Upper Green Sand* than to any other hitherto mentioned, for out of the 111 species, fifty are allowed to be forms of that period, besides fourteen stated to be peculiar to the locality. Any one who visits the quarries of Little Coxwell, will arrive at the conclusion, that the *Sponges* and the *Brachiopoda* (*almost all Upper Green Sand* or *Tourtia* forms) are the *truly abundant and characteristic fossils of the locality*, and that the sprinkling from other classes are *the rarities*, and should not therefore supersede the higher claims of the first. Among the Brachiopoda, two only, *Ter. tamarindus* and *T. oblonga*, are, properly speaking, *Lower Green Sand* fossils, but the last has also been found *as an exception* in the *Upper Green Sand*, near Warminster; and so very rare are these two species at Farringdon, that during two long days' search, I was unable to obtain a *single fragment*, nor do I believe that in all the collections, half-a-dozen examples could be assembled, while specimens of most of the other species may be collected by thousands.¹

Mr. Sharpe publishes the following list of species :

- | | |
|---|--|
| 1. <i>Terebratula depressa</i> , Lamarck. | 11. <i>Terebratella Menardi</i> , Lamarck. |
| 2. „ <i>nerviensis</i> (var. F), D'Archiac. | 12. <i>Rhynchonella latissima</i> , Sowerby. |
| 3. „ <i>Boubei</i> , D'Archiac. | 13. „ <i>depressa</i> , „ |
| 4. „ <i>Roemeri</i> , „ | 14. „ <i>nuciformis</i> , „ |
| 5. „ <i>Keyserlingi</i> , „ | 15. „ <i>triangularis</i> , Wahlenberg. |
| 6. „ <i>biplicata</i> , Sowerby. | 16. „ <i>antidichotoma</i> , ? Buy. |
| 7. „ <i>tamarindus</i> , „ | 17. <i>Crania cenomanensis</i> , D'Orbigny. |
| 8. „ <i>oblonga</i> , „ | 18. „ <i>Parisiensis</i> , ? DeFrance. |
| 9. „ <i>revoluta</i> , D'Archiac. | 19. <i>Thecidia Wetherellii</i> , Morris. |
| 10. „ <i>Robertoni</i> , „ | |

Having also had the opportunity of examining several hundred specimens from the locality, in addition to all those assembled by Mr. Sharpe, and kindly placed by that gentleman at my disposal for publication, I am tempted to suggest a few alterations to Mr. Sharpe's list, having considered it a duty throughout this work to frankly express the results of my own investigations, which are also open to correction and criticism. Thus, according to my impression, the Brachiopoda hitherto obtained from Farringdon would belong to the following species :

1. *Crania cenomanensis*, D'Orbigny. *One upper valve* (*C. Parisiensis* of Mr. Sharpe's list), which perfectly agrees with the type specimens from the *Upper Green Sand* of Mans (France), described by M. D'Orbigny; *one lower valve* (referred by Mr. Sharpe to *C. cenomanensis*), but as it is the only *lower valve* hitherto discovered, I cannot so positively affirm that it belongs to D'Orbigny's species, although it probably is so.

¹ Generally in single valves; bivalve examples are less abundant. It was evidently a littoral deposit accumulated in water much agitated, the dislocation of the valves of the Brachiopoda, and fractured condition of the test of the cidaris, &c., as well as the rolled state of the gravel, attest sufficiently its formation.

2. *Thecidium Wetherellii*, Morris? (not abundant). This identification is founded on the examination of several *ventral* or *dental valves* found adhering to *Tereb. depressa* (Lamarck), *Briozoa*, &c. The characteristic or *dorsal valve* not having hitherto been discovered in the locality, the identification may still be considered incomplete, although there is every probability of its being the same as that described by Mr. Morris from the Chalk of Kent.
3. *Terebratella Menardi*, Lamarck, sp. (common). This *Upper Green Sand* species has also been discovered (by Mr. Wiest) in the *Scaphites bed* at Chardstock, in company with other well-known *Upper Green Sand* Brachiopoda; but I differ with Mr. Sharpe in his assertion that Leymerie's var. *oblongata* ('Mém. Soc. Geol. France,' vol. v, pl. 15, fig. 12) is found at Farringdon. *T. Menardi* (*T. truncata*, Sow.), from Little Coxwell, is a less developed race, but perfectly agrees in character with the true Lamarckian type found at Mans (France).
4. *Terebratula biplicata* (Brocchi). Not abundant, but exactly similar to those so common in the *Upper Green Sand* of Warminster, and the *Chloritic Marl* of the Isle of Wight.
5. „ *Tornacensis*, var. *Ræmeri*? D'Archiac (very common). Mr. Sharpe's views on this point differ somewhat from my own. That gentleman considers Viscount d'Archiac's *T. Ræmeri* specifically distinct from the same author's *T. Tornacensis*; but I agree with M. d'Orbigny and others while stating that *T. Ræmeri* is only a difference of age or variety of *T. Tornacensis*, and am of opinion that the shells described by Mr. Sharpe as *T. Ræmeri*, from Farringdon, are nothing more than a dwarf race or variety of the full-grown *T. Tornacensis*; this view may perhaps prove erroneous, as well as that of my placing *T. Boubei*, *Keyserlingi*, and *revoluta* of Mr. Sharpe's list, among the varieties of *T. Tornacensis*.
6. „ *depressa*, Lamarck (common; a well-known Tourtia species). *T. Nerviensis*, var. *E* of Mr. Sharpe's list, appears to me to be nothing more than a variation due to age.
7. „ *Robertoni*, D'Archiac (rare). A Tourtia shell.
8. „ *tamarindus*, Sow. *Very rare*, only hitherto known in Lower Green Sand.
9. „ *oblonga*, Sow. Equally rare, and, properly speaking, a *Lower Green Sand* fossil.

10. *Rhynchonella latissima*, Sow. (abundant). A well-known *Upper Green Sand* shell, plentiful at Warminster and at Chardstock, also in the Tourtia, &c. *R. antidichotoma*, Buv., of Mr. Sharpe's list, is nothing more than a variety or accident in the plication of Sowerby's shell.
11. „ *depressa*, Sow. This species has been likewise obtained from the *Upper Green Sand* near Warminster, Chardstock, the Isle of Wight, &c., and varies greatly in shape and number of the plaits.

It may, perhaps, be *Rh. triangularis* of Wahlenberg, but I feel unable to concur in the opinion expressed by Mr. Sharpe that both Wahlenberg's and Sowerby's species occur at Farringdon, if they be distinct.

12. *Rhynchonella nuciformis*, Sow. (not quite so common as *R. depressa*), is a well-known *Upper Green Sand* shell, and is found both at Chardstock and in the Isle of Wight, &c.

I have not, therefore, been able to recognise positively more than twelve out of Mr. Sharpe's nineteen species, but admit, at the same time, that there did exist among the specimens obtained some few valves which might admit of doubt; but the material in our possession was not sufficiently perfect to warrant a positive identification. No locality seems (palæontologically speaking) more anomalous than Farringdon, and from the problematic condition of its sands and gravel, is worthy of still further investigation.

The only well authenticated British *Lower Green Sand* species I have been able to examine, are:

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|--|--|
| 1. <i>Lingula truncata</i> , Sowerby (p. 6). | 5. <i>Terebratula celtica</i> , Morris (p. 73). |
| 2. <i>Terebratula oblonga</i> , Sowerby (p. 51). | 6. „ <i>sella</i> , Sowerby (p. 59). |
| 3. „ <i>prælonga</i> , Sowerby (p. 58). | 7. <i>Rhynchonella Gibbiana</i> , Sowerby (p. 98). |
| 4. „ <i>tamarindus</i> , Sowerby (p. 74). | 8. „ <i>parvirostris</i> , Sowerby (p. 97). |

But, besides these eight, imperfect examples of one or two doubtful shells were placed into my hands, which I was unable to identify.

In the Catalogue of *Lower Green Sand* fossils, published by Professor Forbes,¹ mention is not made of other species, if we except those quoted from Farringdon, and which have been found in no authenticated *Lower Green Sand* locality with which I am acquainted. Mr. S. H. Saxby, who has minutely explored the Cretaceous strata of the Isle of Wight, informs me (while placing his whole collection at my disposal for examination) that “Brachiopoda are by no means prominent in *Lower Green Sand* catalogues; indeed there are only two species that can be termed common, viz., *T. sella* and *R. parvirostris*, and these, especially the former, in such profusion as only Brachiopoda know how to lavish. It is, moreover, not a little remarkable that the *Cracker bed*, which furnishes the most

¹ ‘Quarterly Journal of the Geol. Soc.,’ vol. i, p. 345, 1845.

characteristic and beautiful fossils of the series, is totally barren of them ; I never knew of the occurrence of the least trace of a Brachiopod for the first hundred and fifty feet as we ascend, except in the five or six feet of *Perna bed* at the base. In the upper beds, to the depth of more than 200 feet, nearly 300 perhaps, there is a great dearth of fossils of any description ; I have, however, obtained a specimen of *Rh. Gibbsiana* from the uppermost portion. The nodular beds of Horseledge and Black Gang Chine present a very curious analogy with the Cracker nodules, in the repetition of ferruginous casts of those fossils which we saw in the latter as delicate shells, and which in very many instances do not seem to appear between these points in the series, a distance of perhaps 500 feet. Now, the *Horseledge* or *Yellow Ledge* beds contain *Lingula truncata*, *Ter. celtica*, *T. tamarindus*, *T. sella*, and *Rh. parvirostris*, while the Crackers are apparently deficient of these species."

It is, therefore, evident that the *Lower Green Sand* in England contains the *minimum*, and not the *maximum* of species.

THE GAULT and its dependencies dispose but of few species of Brachiopoda, and these no where numerically abundant, and, with the exception of *T. sella*, appear specifically different from those common to the Lower Green Sand.

The following is a list of the forms I have hitherto been able to examine :

1. *Terebratulina striata*, Wahl., var. *pentagonalis*, Phillips. One example from the Speeton Clay.
2. „ *gracilis*, Schl., var. Common, according to Mr. C. B. Rose, in the *Blue Gault* of West Norfolk.
3. *Terebratula capillata* ? D'Archiac (rare). Three or four examples from the *Red Chalk* of Hunstanton Cliffs (Norfolk).
4. „ *biplicata*, var. Sow. Occasionally met with, but nowhere abundantly, in the *Speeton Clay*, *Gault*, and *Red Chalk*.
5. „ *sella*, Sow. (very rare). In the *Gault* near Maidstone.
6. „ *semiglobosa*, Sow., var. *subundata* (rare). In the *Red Chalk*;¹ and this appears to be the first appearance of the species which continues to be represented in each successive deposit up to the Chalk.
7. *Rhynchonella sulcata*, Parkinson. A few rare examples from the *Speeton Clay* and *Gault*.
8. „ *lineolata*, Phillips, sp. A single specimen from the *Speeton Clay* of Yorkshire.

Over the GAULT, in natural succession, we arrive at a very variable series of sandy and marly beds, with occasional bands of limestone, known under the appellations of *Upper Green Sand*, *Chloritic Marl*, *Tourtia* and *Craie et Sables Chlorités* by the French; and it is in the direct succession or equivalents in different localities of the layers forming this series of beds, between the *Gault* and the *Chalk Marl*, that some further investigation

¹ Mr. C. B. Rose states that the *red bed*, (improperly called *Chalk*), occupies the place of the *Gault* lying immediately upon the Lower Green Sand; the fossils are similar to those met with in other *Gault* districts (see 'Ed. Phil. Journal,' Nov. and Dec. 1835, and Jan. 1836): at Hunstanton Cliff the *red bed* measures about 3 feet 10 inches.

is required: but viewing all the beds as one whole, we recognise therein from twenty-eight to thirty species, or the *maximum* of specific and numerical development of the Brachiopoda in the Cretaceous system in Great Britain.

In the Isle of Wight two well-separated beds may be traced above the Gault. First, the *Upper Green Sand*, from which Mr. S. H. Saxby procured *Lingula sub-ovalis* (Dav.), a *Terebratula*, probably *T. squamosa* (Mantell), *Ter. biplicata*, var. (Sow.), *Rh. nuciformis* (Sow.), and *R. depressa* (Sow.). The second bed is termed the *Chloritic Marl*, and from which the same gentleman obtained *Ter. biplicata* (Brocchi), *T. pectita* (Sow.), *Rh. Grasiana* (D'Orb.), *R. compressa* (Lamarck), and *R. Mantelliana* (Sow.). The fossils from both being identically similar to those so abundantly found in the neighbourhood of Warminster.¹

One of the most interesting localities in England for the study of the beds under notice is the neighbourhood of Chard and Chardstock, and I am particularly indebted to Mr. J. Wiest for the following details.

“The formations about to be described are situated chiefly, if not exclusively, on each side of the valley of the Kit, and consist of the following beds taken in the descending order:”

- I. LOWER CHALK without flints, from two to thirty feet in thickness at different places; its fossils are those common to that deposit and age.
- II. CHALK MARL or *Discoidean stratum*, from two to three feet in thickness, representing a homogeneous mass, with fine siliceous and chloritic grains; it spreads out more equally than No. I, but does not appear to be present where the last attains a considerable thickness. *Am. Mantelli*, *Discoidea cylindrica*, and *Ananchites subglobosa*, are amongst its fossils.
- III. The SCAPHITES BED, harder than I and II., and, before becoming exposed to air and damp, a compact accumulation of fossils, from three to nine inches in thickness; siliceous grains, more numerous and rough than in II, are interspersed in the mass. *Scaphytes*, *Nautilus triangularis*, Montfort, = *Fleuriusianus*, *N. laevigatus*, *Am. varians*, *A. obtectus*, and *Galerites*, are amongst its fossils.
- IV. GREEN BED, near Chardstock, distinctly separated from III, forms a hard compact mass of rocks, with abundant siliceous and chloritic grains; from six inches to three feet in thickness, and containing the greatest variety of fine fossils. *Nucleolites Morrisii*, *N. lacunosus*, *Ter. lyra*, and other Upper Green Sand fossils characterise that deposit.
- V. CRUSTACEAN STRATUM, less cemented than IV, with siliceous grains predominant; one to three feet in thickness. It contains a few *Terebratulæ*, *Pectens*, but chiefly remains of Crabs.

¹ Consult also the valuable ‘Memoirs on the Geology of the Isle of Wight,’ &c., by Dr. Fitton, Professor Forbes, and others, published in the ‘Transactions and Quarterly Journal of the Geol. Soc. of London.’

VI. NAUTILUS LÆVIGATUS LAYER, a loose sand, nearly one foot in thickness, and containing but few fossils. *N. lævigatus* is also found in the Farringdon Sand and Gravel.

These details were accompanied by a numerous collection of all the Brachiopoda peculiar to the locality, and after minute examination, I have referred the individuals to the following species. The stratigraphical distribution is given on Mr. Wiest's authority.

	I.	II.	III.	IV.	V.
<i>Terebratula semiglobosa</i> , Sowerby	*	*	* ?	
„ <i>squamosa</i> , Mantell	*	*	*		
„ <i>rugulosa</i> , Morris	*	*		
„ <i>ovata</i> , Sowerby	*	
<i>Megerlia lima</i> , Defrance	*	
<i>Terebratella Menardi</i> , Lamarck	*		
„ <i>pectita</i> , Sowerby	*	*
<i>Terebrirostra lyra</i> , Sowerby	*	*
<i>Trigonosemus incerta</i> , Davidson	*	* ?		
<i>Rhynchonella latissima</i> , Sowerby	*	*	*	
„ <i>compressa</i> , Lamarck	*	*	*	
„ <i>depressa</i> , Sowerby, var. <i>A.</i> and <i>B.</i>	*	
„ <i>nuciformis</i> , Sowerby	*	*
„ <i>Grasiana</i>	*	*
„ <i>Cuvieri</i>	*	*		

Chardstock is, therefore, a particularly interesting locality; it exhibits the British equivalents of the *Craie chloritée* of France and the *Tourtia* of the Belgians. II and III entirely agrees in mineral composition, external aspect, and palæontological contents, with the *Craie Chloritée* of the Mont St. Catherine, near Rouen (France), and in both localities we find *Ter. rugulosa*, *T. squamosa*, as well as the generality of fossils peculiar to that age. III constitutes by its fossils a natural passage into IV, which last contains the greatest number of species common to the *Upper Green Sand* of Warminster; Havre (France), and the *Tourtia* of Belgium; among the Brachiopoda we may mention *Ter. lyra*, *T. ovata*,¹ *T. pectita*, *Meg. lima*, *Rh. latissima*, *R. compressa*, *R. Grasiana*, *R. depressa*, and *R. nuciformis*.

In England, the neighbourhood of Warminster has yielded by far the greatest number of Upper Green Sand Brachiopoda, it contains—

¹ I have found *Ter. ovata*, *M. lima*, and *Rhyn. lineolata*, in the *Tourtia* near Tournay, species not recorded in Viscount D'Archiac's memoir.

- | | |
|--|--|
| 1. <i>Lingula sub-ovalis</i> (rare). | 10. <i>Terebratula biplicata</i> (very common). |
| 2. <i>Argiope megatrema</i> (very rare). | 11. „ <i>oblonga</i> (very rare). |
| 3. <i>Terebratella pectita</i> (common). | 12. <i>Rhynchonella compressa</i> . |
| 4. <i>Terebrirostra lyra</i> (not abundant). | 13. „ <i>latissima</i> (common). |
| 5. <i>Megerlia lima</i> . | 14. „ <i>depressa</i> , var. <i>A</i> and <i>B</i> . |
| 6. <i>Terebratulina striata</i> (var.). | 15. „ <i>sulcata</i> . |
| 7. <i>Terebratula squamosa</i> . | 16. „ <i>Grasiana</i> (common). |
| 8. „ <i>ovata</i> (common). | 17. „ <i>Mantelliana</i> . |
| 9. „ <i>obesa</i> . | |

At Cambridge, immediately above the Gault, we find a bed of *Upper Green Sand*, from which Mr. Carter has obtained—

- | | |
|---|--|
| 1. <i>Argiope megatrema</i> , Sow., = (<i>decemcostata</i> , Roemer) (rare). | 4. <i>Terebratula biplicata</i> , var. <i>Dutempleana</i> and var. <i>obtusata</i> (common). |
| 2. <i>Megerlia lima</i> (not very common). | 5. <i>Rhynchonella sulcata</i> (common). |
| 3. <i>Terebratulina gracilis</i> , var. <i>rigida</i> . | 6. „ <i>lineolata</i> . |

Other similar British localities have yielded species, but no where different from those already enumerated. Nor have I yet been able to obtain any specimen of Brachiopoda from the celebrated Blackdown beds, although several species have been more than once erroneously mentioned as from that locality.¹

From the CHALK MARL and LOWER CHALK we have obtained—

- | | |
|--|---|
| 1. <i>Crania Ignabergensis</i> (rare). | 9. <i>Terebratulina striata</i> . |
| 2. <i>Magas pumila</i> (rare). | 10. „ <i>gracilis</i> . |
| 3. <i>Terebratula squamosa</i> . | 11. <i>Argiope Bronnii</i> (1 example). |
| 4. „ <i>obesa</i> . | 12. <i>Rhynchonella plicatilis</i> . |
| 5. „ <i>biplicata</i> (rare). | 13. „ <i>Mantelliana</i> . |
| 6. „ <i>sulcifera</i> . | 14. „ <i>Cuvieri</i> . |
| 7. „ <i>semiglobosa</i> (common). | 15. „ <i>Martini</i> . |
| 8. „ <i>Carteri</i> (rare). | |

And from the CHALK WITH FLINTS—

- | | |
|--|--|
| 1. <i>Crania Parisiensis</i> . | 9. <i>Terebratulina gracilis</i> . |
| 2. „ <i>Ignabergensis</i> | 10. <i>Terebratula obesa</i> . |
| 3. <i>Thecidia Wetherellii</i> . | 11. „ <i>carnea</i> . |
| 4. <i>Argiope Bronnii</i> . | 12. „ <i>semiglobosa</i> . |
| 5. <i>Magas pumila</i> . | 13. <i>Rhynchonella plicatilis</i> . |
| 6. <i>Trigonosemus elegans</i> (rare). | var. <i>octoplicata</i> . |
| 7. <i>Megerlia lima</i> . | var. <i>Woodwardii</i> . |
| 8. <i>Terebratulina striata</i> . | 14. „ <i>limbata</i> (sub- <i>plicata</i>). |

And perhaps one or two others which I was unable to determine, so that eight or nine species pass from *Lower* and *middle Chalk* into the *Chalk with flints*.

¹ Mr. Sharpe is of opinion that Blackdown Sands are older than the Upper Green Sand ('Quart. Journ. of the Geol. Soc.,' vol. x, p. 187, 1853).

For collecting the last-mentioned species, the following localities may be named. Norwich, Swaffham, Gravesend, Northfleet, Cambridge, Brighton, Lewes, Folkstone, &c.

France is infinitely richer than Great Britain in Cretaceous Brachiopoda, and this will be easily accounted for when we remember that the *ETAGE NÉOCOMIEN* (of which our *Lower Green Sand* only constitutes a small part) occupies a considerable portion of France, where it acquires vast thickness and importance, contains there likewise the maximum of Cretaceous species, and in it are found all those beautiful forms which materially help to make up the eighty-nine species or varieties which have been figured and described by M. d'Orbigny in the fourth volume of the '*Paléontologie Française, Terrain Crétacées*;' but it is much to be regretted that the distinguished author had not been better acquainted with some of our British types, as a few of them have therein either received new names or been misunderstood. We possess, however, several forms which have not been as yet recorded in French catalogues, such as *Lingula sub-ovalis*, *Thecidium Wetherelli*, *Argiope megatrema*, *Trigonosemus incertum*, *Ter. capillata*, *T. Robertoni*, *T. depressa*, *T. Carteri*, and *Rh. lineolata*.

The following is the distribution of the French Cretaceous Brachiopoda according to M. d'Orbigny :

I. Etage Néocomien	{ Inferieur ou Néocomien	22
	{ Supérieur ou Ungonien	7
II. Etage Aptien		5
III. Etage Albien		11
IV. Etage Cénomenien		16
V. Etage Turonien		7
VI. Etage Senonien		23
But as three are repeated, the total amount of Cretaceous species or varieties known to M. d'Orbigny would be about		88

PLATE VI.

CRETACEOUS SPECIES.

Fig.			
1 to 2.	<i>Terebratula</i>	<i>biplicata</i> , <i>var.</i> <i>Dutempleana</i> , <i>D'Orb.</i> ,	from the Red Chalk of Hunstanton.
3 to 5.	"	"	Upper Green Sand, Cambridge.
6.	"	"	" " " " , a specimen exhibiting remains of colour.
7.	"	"	Upper Green Sand, Cambridge ; interior of dorsal valve.
8, 9.	"	"	from Cambridge ; intermediate shape between <i>T. biplicata</i> (type) and the <i>var. Dutempleana</i> .
10 to 13.	"	"	<i>var. obtusa</i> , <i>Sow.</i>
14 to 28.	"	"	Different shapes from the Upper Green Sand of Cambridge.
29, 30.	"	"	from the Gault, Folkstone.
31, 32.	"	"	Two examples, from the Lower Chalk of Cambridge and Lewes.
33 to 42.	"	"	(<i>Brocchi</i>). A series of specimens and varieties from the Upper Green Sand, near Warminster, and which appear to approach most to the Italian figure.
43, 44.	"	"	(<i>T. faba</i> , <i>Sow.</i>)
45 to 49.	"	"	? Stated to be from Lower Green Sand, near Devizes by Mr. Cunnington.

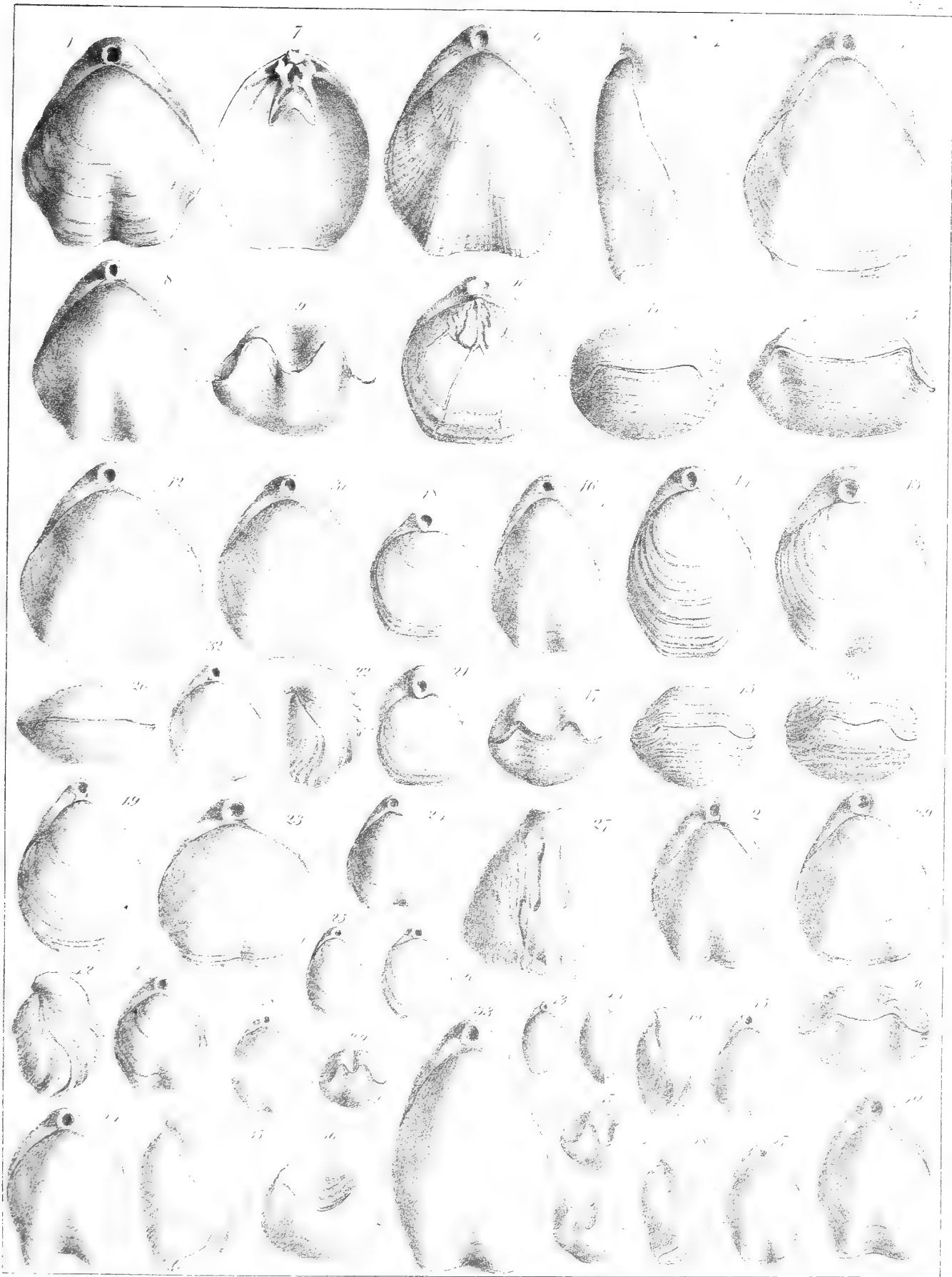


PLATE VII.

CRETACEOUS SPECIES.

Fig.

- | | | |
|-----------|--|--|
| 1. | Terebratula praelonga, <i>Sow.</i> | The original figure, Lower Green Sand, Sandgate. |
| 2. | „ „ | A fine example, from Maidstone. |
| 3. | „ Carteri, <i>Dav.</i> | From Lower Chalk, Dover. |
| 4. | „ sella, <i>Sow.</i> | A very adult individual, from the Lower Green Sand, Isle of Wight. British Museum. |
| 5 to 6 | „ „ | Ibid. |
| 7. | „ „ | Gault, near Maidstone |
| 8 to 10. | „ „ | Isle of Wight. |
| 11 to 16. | „ Tornacensis, <i>var. Roëmeri</i> ? <i>D'Archiac.</i> | A small race, Farringdon Sponge Sand and Gravel. See also Pl. IX, figs. 1 to 8. |
| 17 to 20. | „ sulcifera, <i>Morris.</i> | Different shapes ; Lower Chalk, Cambridge. |

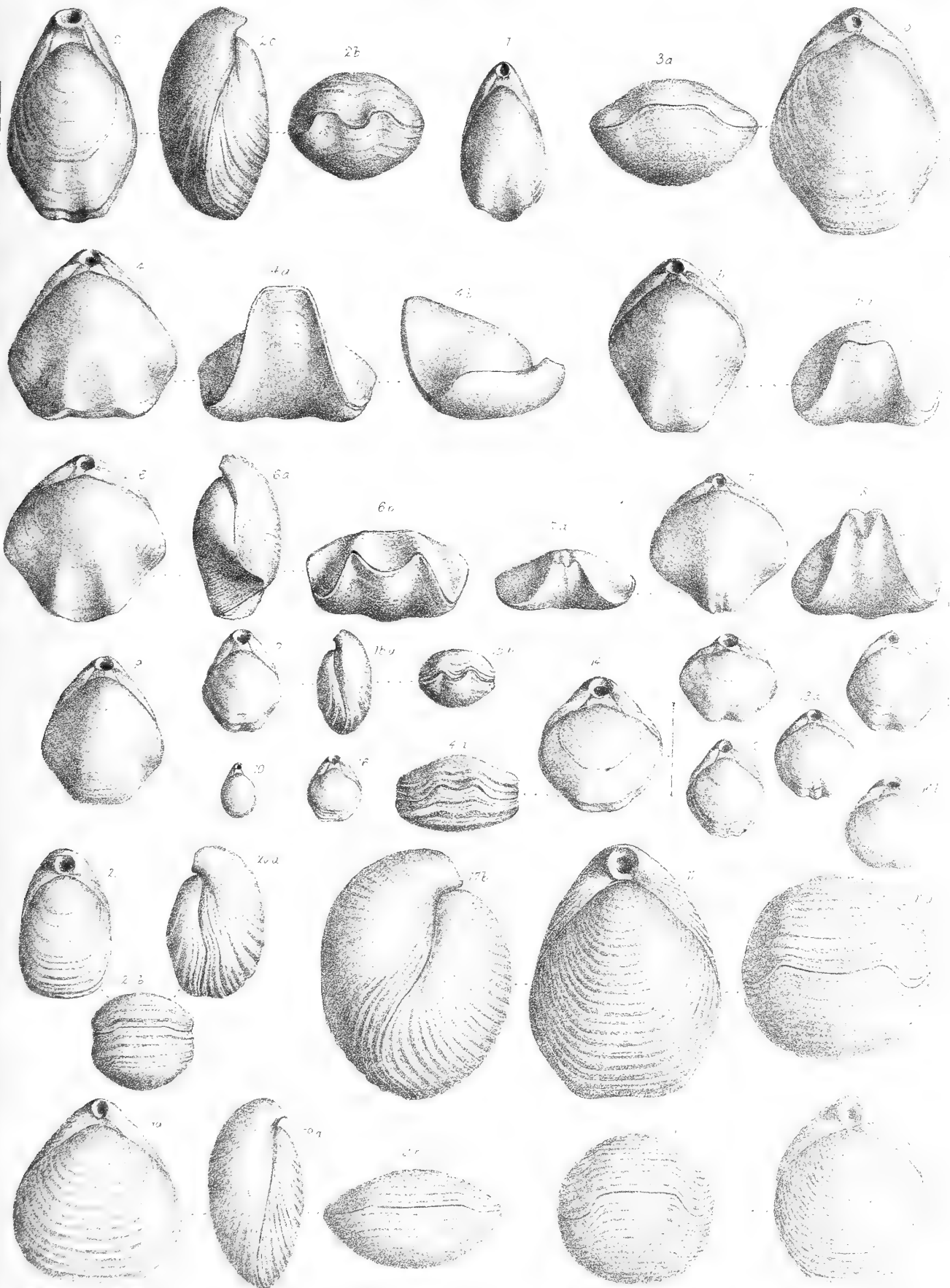


PLATE VIII.

CRETACEOUS SPECIES.

Fig.			
1.	<i>Terebratula carnea</i> , Sow.	A typical shape, Chalk, Trimmingham.	
2.	„	„	Interior of ventral or dental valve.
2".	„	„	Interior of dorsal or socket valve.
3.	„	„	(var. <i>elongata</i> , Sow.). Norwich.
4 to 5.	„	„	Circular variety, from „
6.	„	semi-globosa, Sow.,	from the Lower Chalk, near Lewes.
7.	„	„	A circular specimen, from Gravesend.
8.	„	„	A remarkable variety, from Lewisham, Kent.
9.	„	„	Original figure of Sowerby's <i>T. subrotunda</i> .
10 to 11.	„	„	(var. <i>T. bulla</i> , J. de C. Sow.).
12.	„	„	A var., from Grays.
13.	„	„	(var. <i>T. albensis</i> , Leymerie), from Charing, Kent.
14.	„	„	A malformation.
15 to 16.	„	„	(var. <i>T. albensis</i>).
17.	„	„	(var. <i>subundata</i> , Sow.), from the Red Chalk, Hunstanton.
18.	„	„	from the Chalk with Quartz Grains, Evershot, Dorsetshire.

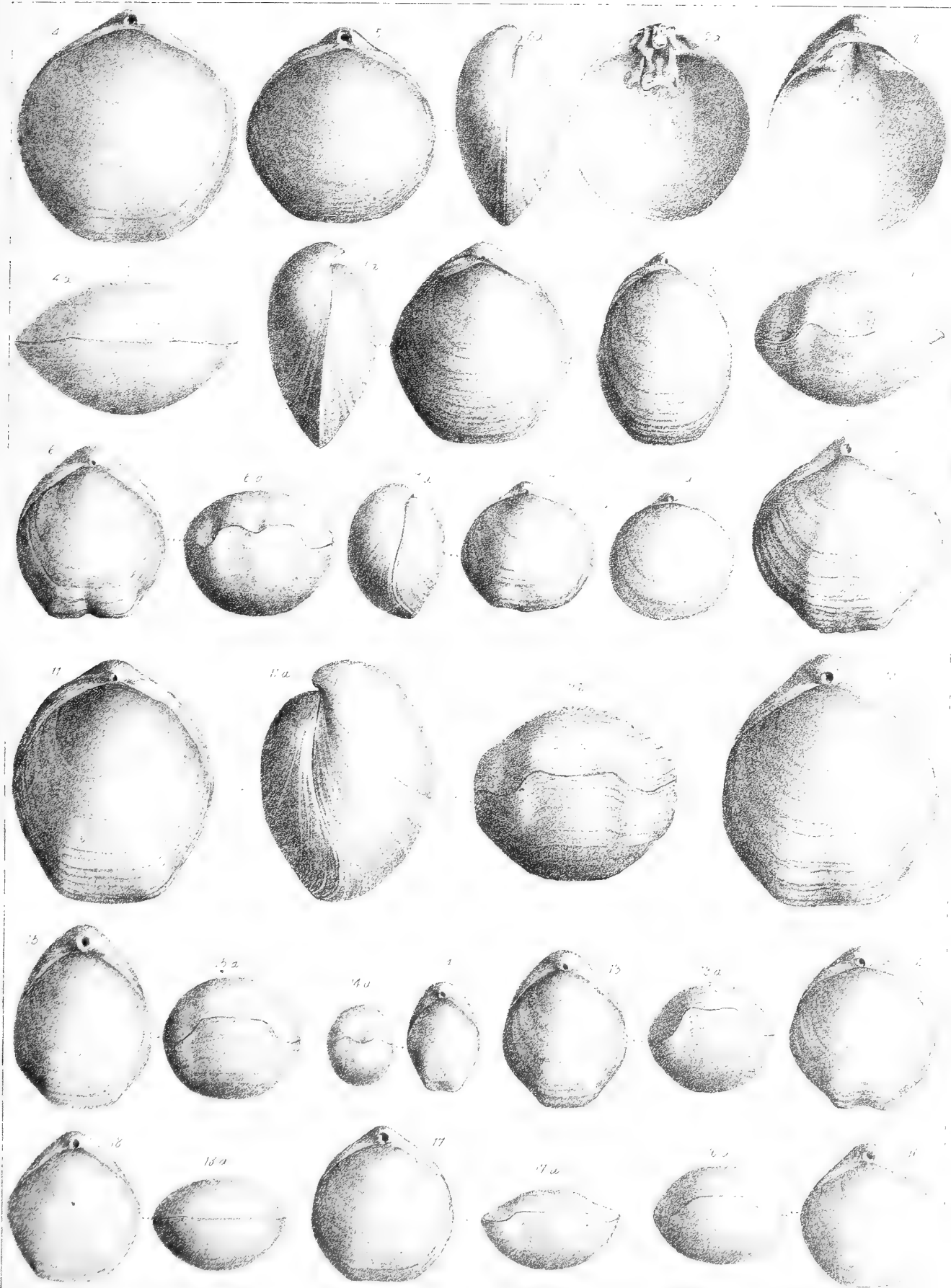


PLATE IX.

CRETACEOUS SPECIES.

Fig.

- | | | | |
|-----------|--------------------------------------|------------------------------|--|
| 1 to 8. | Terebratula Tornacensis, <i>var.</i> | Roëmeri, <i>D'Archiac.</i> | A dwarf race, from the Farringdon Sponge Sand and Gravel. See also Pl. VII, figs. 11—16. |
| 9 to 24. | ,, | depressa, <i>Lamarck.</i> | A series of shapes, age, and varieties, from the Farringdon Sponge Gravel. 15. Interior of the dorsal or socket valve. |
| 25. | ,, | Robertoni, <i>D'Archiac.</i> | Ibid. |
| 26. | ,, | tamarindus, <i>Sow.</i> | Lower Green Sand, near Sandgate. |
| 27, 28. | ,, | ,, | Farringdon Sponge Sand and Gravel (rare): |
| 29 to 31, | ,, | ,, | Different shapes, from the Isle of Wight. |
| 32 to 34. | Waldheimia | Celtica, <i>Morris.</i> | Different ages, from the Lower Green Sand, Isle of Wight. |
| 35. | ,, | ,, | Interior of the dorsal or socket valve. |
| 36. | Terebratula | Tornacensis? | Farringdon. |
| 37. | ,, | biplicata, <i>Brocchi.</i> | Farringdon. |
| 38. | ,, | ? | Farringdon; only two or three dorsal valves have been found. |
| 39. | ,, | ? | perhaps, a var. of <i>T. sella</i> , from the Lower Green Sand, Maidstone. |
| 40. | ,, | biplicata? | from the highest bed of Lower Green Sand, Folkstone. |

Note.—Figs. 36, 38, 39, and 40, are doubtful forms; the want of sufficient material has prevented more positive identification.

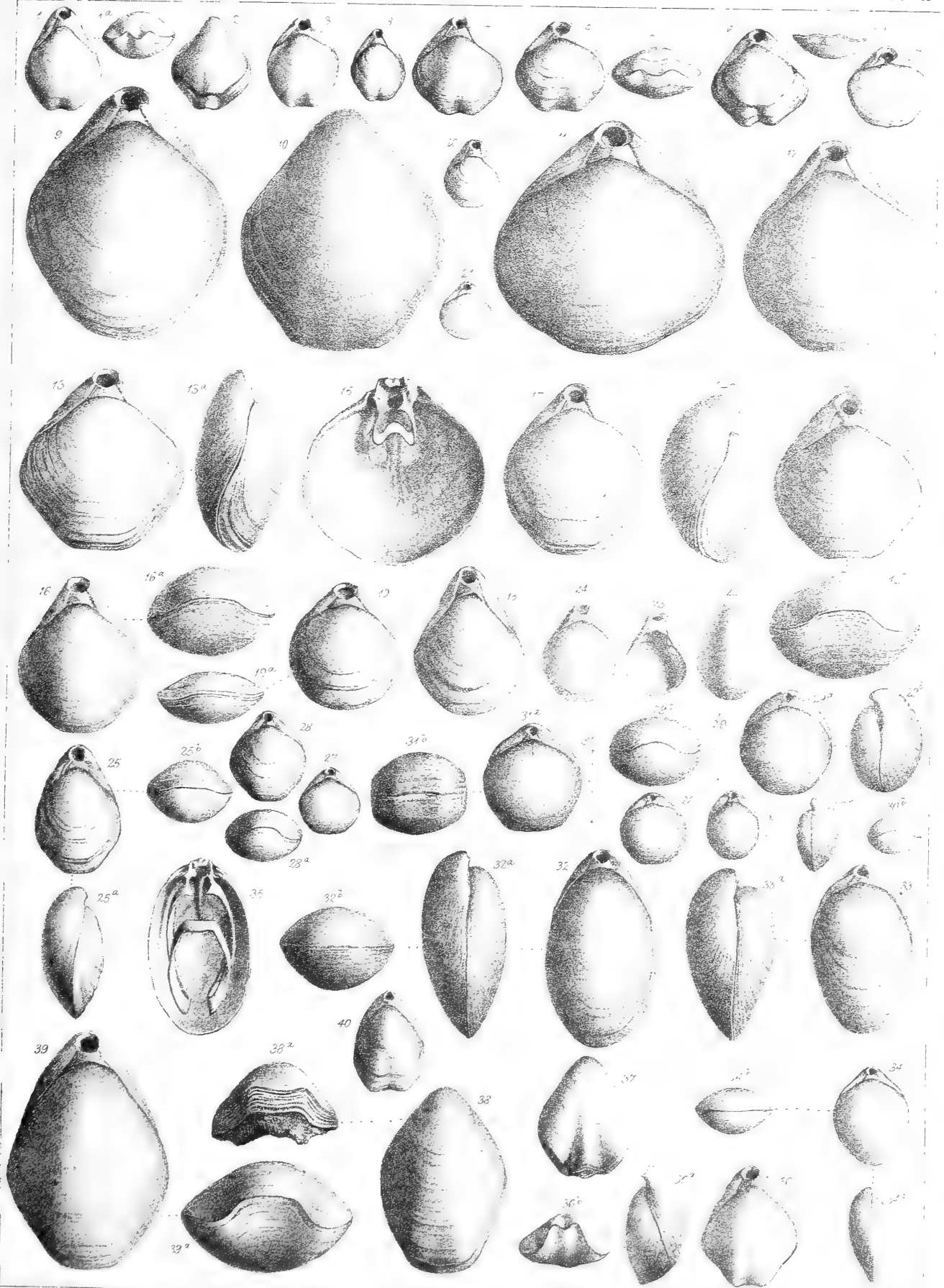


PLATE X.

CRETACEOUS SPECIES.

Fig.

- 1 to 17. *Rhynchonella plicatilis*, *var. octoplicata*, *Sow.* A series of specimens and varieties from the Chalk of Norwich.
- 18 to 20. ,, *sulcata*, *Parkinson.* Upper Green Sand of Cambridge.
- 21, 22. ,, ,, Speeton Clay, Yorkshire.
- 23 to 36. ,, ,, Varieties and malformations, from Cambridge.
- 37 to 40. ,, *plicatilis*, *Sow.* Chalk, Brighton.
- 41, 42. ,, ,, Var. (Kent).
- 43 to 46. ,, ,, (var. *Woodwardi*, *Dav.*).
- 47 to 49. ,, ? Chalk, Charing.
- 50 to 54. ,, *Cuvieri*, *D'Orb.* Lower Chalk.

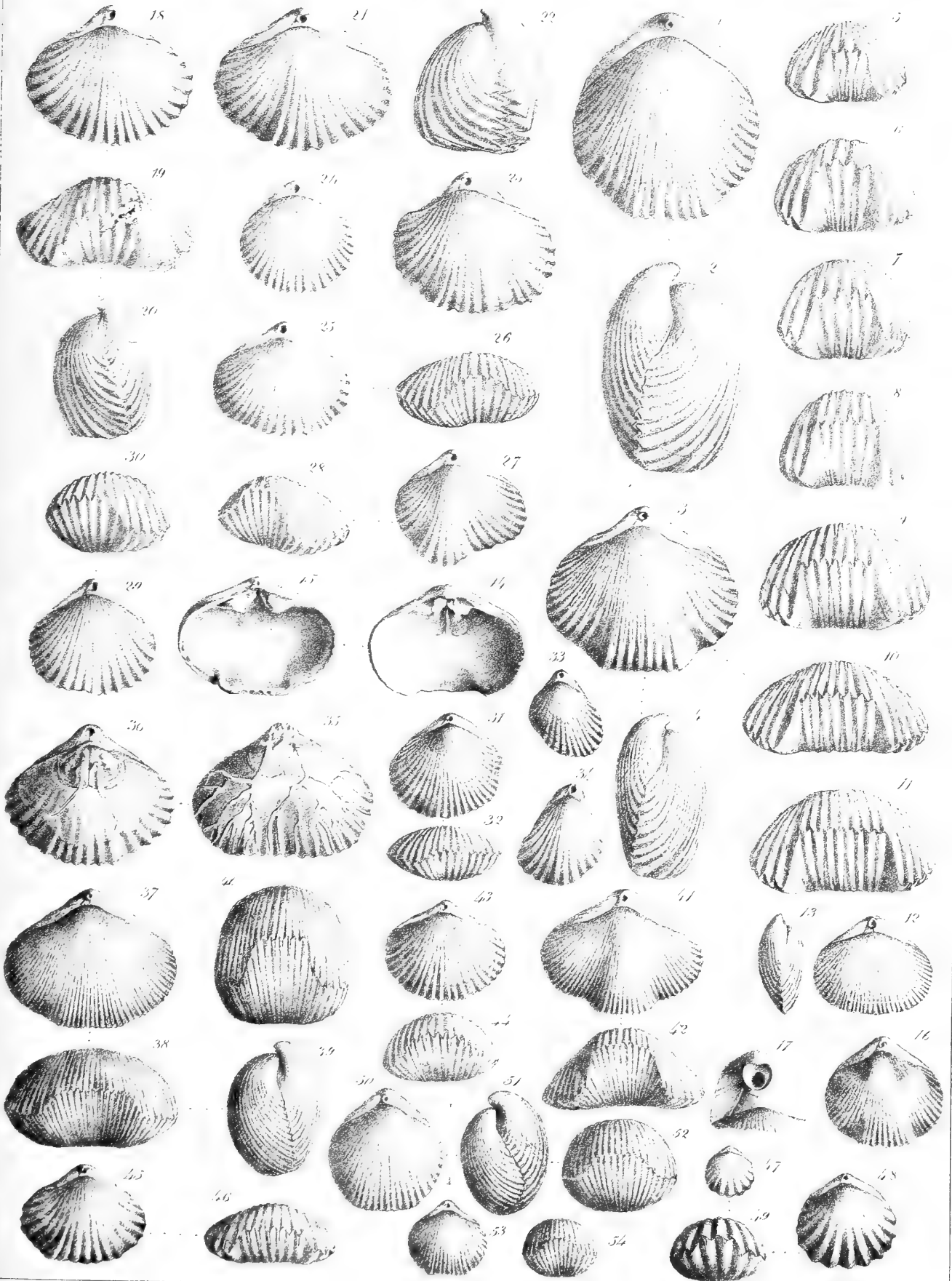


PLATE XI.

CRETACEOUS SPECIES.

Fig.

1. Rhynchonella compressa, *Lamarck*. Upper Green Sand, near Warminster.
(See also Pl. XII, fig. 25.)
2. „ „ (*Ter. dilatata*, Sow.).
3. „ „ A malformation viewed from the front.
4. „ „ „ (*Ter. dimidiata*, Sow.), from Chard.
5. „ „ „ from Warminster.
- 6 to 14. „ latissima (lata) *Sow.* Different examples from the Upper Green
Sand of Warminster. (See Plate XII,
fig. 24.)
- 15 to 22. „ „ Several varieties from Farringdon (*R. antidichotoma*?
Sharpe).
- 23 to 27. „ nuciformis, *Sow.* Several examples from the Farringdon Sponge
Gravel.
- 28^a 29^b 30^c. „ „ Enlarged.
- 28 to 32. „ depressa, *Sow.* Farringdon. (fig. 32, *R. triangularis*, Sharpe).
(See also Pl. XII, fig. 26.)

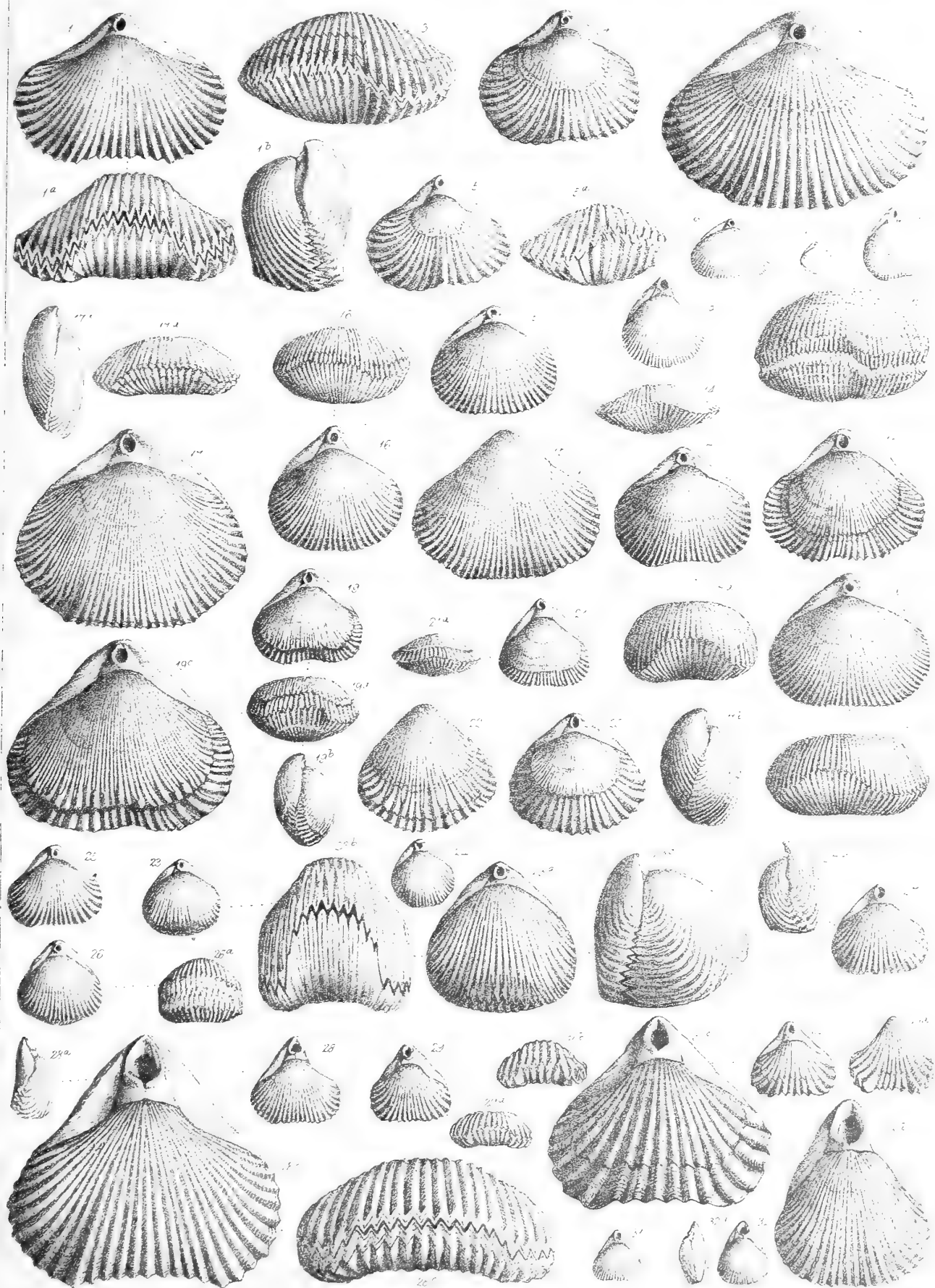


PLATE XII.

CRETACEOUS SPECIES.

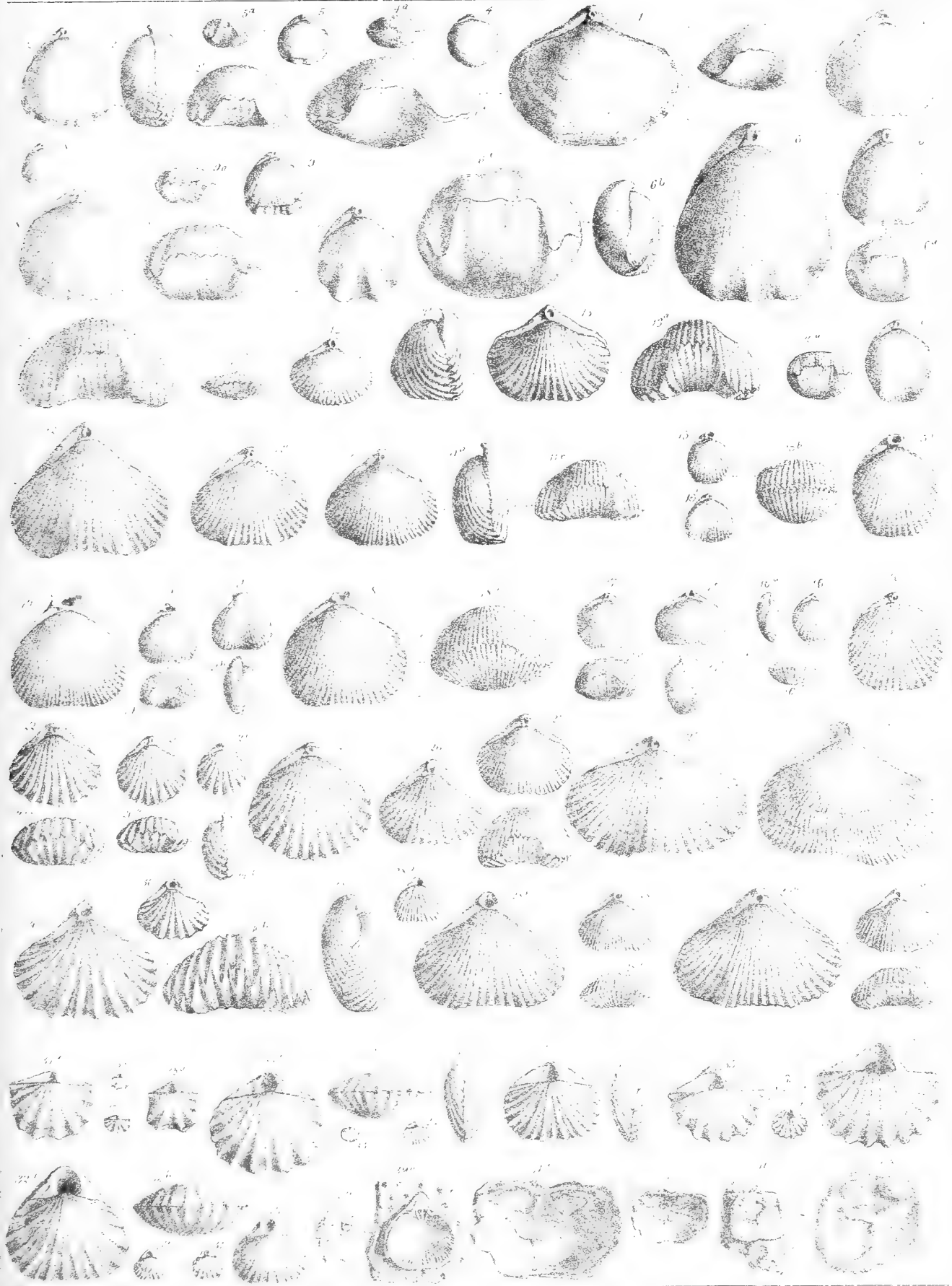
Fig.

- | | |
|-----------------------|---|
| 1 to 5. | Rhynchonella limbata, <i>Schlotheim</i> , 1813 (<i>Ter. sub-plicata</i> , Mantell. Different varieties, from the Chalk Norwich. Figs. 4—5. Var. <i>lentiformis</i> , Woodward. |
| 6 ^{a b} . | „ lineolata, <i>Phillips</i> . Drawn from the original example, from the Speeton Clay, Yorkshire. |
| 6 ^{c d} . | „ „ Enlarged. |
| 7 to 10. | „ „ Small variety or race. Upper Green Sand, Cambridge. |
| 11. | „ Gibbsiana, <i>Sow</i> . Lower Green Sand, Isle of Wight |
| 12 ^a . | „ „ Slightly enlarged, from Pluckley, Kent. |
| 12 ^c . | „ „ Another example; nat. size. |
| 13, 14. | „ parvirostris, <i>Sow</i> . Figs. 13, adult; 14, young; from the Lower Green Sand, Isle of Wight. |
| 15. | „ Martini, <i>Mantell</i> (= <i>Ter. pisum</i> , <i>Sow</i> .). A typical shape, from the Gray Chalk, Folkstone. |
| 15 ^{a b} . | „ „ Enlarged. |
| 16 ^{a b} . | „ „ Chalk detritus, Charing. |
| 16 ^c . | „ „ Enlarged. |
| 16 ^d . | „ „ Upper Green Sand, Warminster. |
| 17, 18. | „ Grasiana, <i>D'Orb</i> . Upper Green Sand, Warminster; fig. 18 enlarged. |
| 19 ^{a b c} . | „ „ Warminster. |
| 19 ^d . | „ „ Enlarged. |
| 20, 21. | „ Mantelliana, <i>Sow</i> . Lower Chalk, Folkstone. |
| 22. | „ „ Upper Green Sand, near Warminster. |
| 23. | „ „ ? Lower Chalk, near Lewes. |
| 24. | „ latissima, <i>Sow</i> . A very remarkable specimen, from the Chloritic Marls of Chardstock. |
| 25. | „ compressa, <i>Lamarck</i> . Ibid. |

Fig.			
26.	„	depressa, <i>Sow.</i> var.	Farringdon.
27.	„	nuciformis, <i>Sow.</i> ?	Upper Green Sand, Isle of Wight.
28.	„	depressa, <i>Sow.</i> , var. B.	Chalk, with chloritic grains of Chardstock
28 ^{b c} .	„	„	Enlarged.
28 ^a .	„	„	Young.
29.	„	„	var. ? Upper Green Sand, Shaftesbury.
30.	„	„	var. A. Chardstock.
30 ^{a b} .	„	„	Enlarged.
31.	Argiope	Megatrema, <i>Sow.</i> , sp.	Original figure, 'Trans. Geol. Soc.'
31 ^a .	„	„	Enlarged.
32.	„	„	Upper Green Sand, Warminster.
32.	„	„	Enlarged.
33.	„	Buchii, <i>De Hagenow</i> ?	Lower Chalk, Kent.
33 ^a .	„	„	Enlarged.
34.	„	Megatrema=(decemcostata, <i>Ræmer</i>).	Upper Green Sand, Cambridge.
34 ^{a 4} .	„	„	Enlarged.
35.	„	„	Ræmer's original figure.
35 ^a .	„	„	Enlarged.
36.	„	„	A specimen of the same, from Essen.
36 ^a .	„	„	Enlarged.
37.	„	Bronni, <i>De Hagenow</i> .	His original figure.
38.	„	Bucchi, „	Ibid.

Nota.—Figs. 35 to 38, have been introduced to facilitate comparisons with our British examples, upon which some uncertainty appeared to exist.

39. Thecidium Wetherelli, *Morris*. Sponge Gravel, Farringdon; interior of the ventral or dental valve.
- 39^a. „ „ Enlarged.
- 40 to 41. Crania cenomanensis, *D'Orb*. Farringdon. Fig. 40, lower valve; 41^a, enlarged; 41, upper valve; 41^a, enlarged.



APPENDIX.

BESIDES the few Supplementary additions which this Appendix may contain, it is desirable to point out several corrections resulting from the continued researches undertaken during the four consecutive years devoted to the publication of the present Monographs. Nor was it always possible to avoid certain changes and repetitions resulting from the mode in which the material had unavoidably to be assembled.

INTRODUCTION.

Page 5, line 13.

For "the recent *Atrypa*¹ and the fossil Rhynchonellidæ, which latter, from the general analogy of the structure of their shell, might be supposed to have the respiratory organs at the same low degree of development as the *Terebratulidæ*, and to have the same need," *read* "the Rhynchonellidæ, which have the respiratory organs at the same low degree of development as the *Terebratulidæ* have the same need" (Owen).

Page 7, line 3.

For "perforated valve, D," *read* "imperforated valve, D" (Owen).

Page 9, line 1.

For "called 'thecidium,'" *read* "called 'deltidium'" (Owen).

Page 33, line 23.

Place *T. lunifera* (Philippi) under the genus MORRISIA (line 22).

Page 44.

Add—Mr. S. P. Woodward places the *Rudistes* in his seventh Family of Conchifera, and states that—"They are the most problematic of all fossils; there are no recent shells which can be supposed to belong to the same family; and the condition in which they usually occur, has involved them in greater obscurity. (1. Buch regarded them as Corals. 2. Desmoulins, as a combination of the Tunicary and Sessile Cirripede. 3. Dr. Carpenter, as a group intermediate between the *Conchifera* and *Cirripeda*. 4. Prof. Steenstrup, of Copenhagen, as Anellides. 5. Mr. Sharpe refers *Hippurites* to the Balani; *Caprinella* to the Chamaceæ. 6. Lapeirouse considered the Hippurites, *Orthocerata*; the Radiolites, *Ostracea*. 7. Goldfuss and D'Orbigny place them both with the *Brachiopoda*. 8. Lamarck and Rang, between the *Brachiopoda* and *Ostracea*. 9. Cuvier and Owen, with the Lamellibranchiate bivalves. 10. Deshayes, in the same group with *Ætheria*. 11. Quenstedt, between the *Chamaceæ* and *Cardiaceæ*.) The characters which determine their position amongst the ordinary bivalves, are the following:—1. The shell is composed of two distinct layers. 2. They are essentially unsymmetrical, and right-and-left valved. 3. The sculpturing of the valves is dissimilar. 4. There is evidence of a large internal ligament. 5. The hinge-teeth are developed from the free valve. 6. The muscular impressions are two only. 7. There is a

¹ The shell referred to as a "recent *Atrypa*," is the *Rhynchonella psittacea* (Int. pl. vii, fig. 100—102). It does not belong to the genus *Atrypa* which is furnished with shelly spires (see pl. vii, fig. 89 and 92).

distinct pallial line." ('Manual of the Mollusca,' p. 279, 1854.) Refer also to a very able memoir by the same author, read to the Geological Society, on the 7th June, and published in the 'Quarterly Journal' for the present year.

Page 73, line 6.

Add—M. E. Deslongchamps has published in the 'Annuaire de l'Institut des Provinces,' for 1853 and 1854, descriptions and figures of three remarkable shells or species, discovered by himself and Dr. Périer, in the *Middle* and *Upper Lias* of May, Fontaine-Etoupefour, and Bretteville-sur-Laize, near Caen, by the names of *Argiope Périeri*, *A. Liasiana*, and *A. Suessii*; thus carrying the genus ARGIOPE to the lower portion of the Jurassic system. I will not offer any positive opinion on this question until I have had an opportunity of examining the species in question; but about the period of my friend's publication in 1853, I could not refrain from expressing certain objections or doubts, based upon the character of their plication, which differs so entirely from that of any other species of *Argiope* at present known. The external shape, of one of them in particular, *A. Liasiana*, has much of the external shape of certain forms of *Cyrtia*, especially by its deltidium and position of the foramen? It will therefore be necessary to know more of their internal arrangements, before the place of those remarkable species can be definitely established.

Page 77, THECIDIUM.

The valuable and beautifully illustrated memoir 'On the Brachial Arrangement in Thecidium,' by M. Suess, of Vienna,¹ has afforded us much additional knowledge relative to the internal structure of this remarkable genus; and my only regret is not being able to transcribe the whole of that very important memoir, which does infinite credit to the persevering and able researches of its distinguished author.

M. Suess begins by stating, that the near connection between ARGIOPE and THECIDIUM has already been admitted by several authors, but he forcibly objects to those two genera being considered BRACHIOPODA CIRRHIDÆ, and combined with the RUDISTA, as proposed by M. A. d'Orbigny; the animal having proved that they are not only *true Brachiopoda*, but likewise members of the great Family TEREBRATULIDÆ. He also believes that STRINGOCEPHALUS must be connected, or placed in the same family and close to ARGIOPE; he has observed on the inner edge of the loop of the last, small lamellar projections, similar, although much less developed than in the first-named genus. M. Suess then enters into many interesting details on the variations presented by the loop of ARGIOPE: of which *Arg. decemcostata* and *A. decollata* have afforded the greatest difference. The first approaches most to that of STRINGOCEPHALUS, the second teaches us to understand the more complicated structure in THECIDIUM.

It has been already shown, that the exterior side of the loop of *A. decollata* is at times partially fixed to the bottom of the valve, while the outer margin bears the brachial fringe. Now if we imagine the inferior side to be fixed to the valve and to the septa all the way round, we should have the counterpart of *appareil ascendant*² of *Thecidium digitatum*; and the *appareil descendant* would be wholly wanting in every genus of Brachiopod known to M. Suess. Many authors, he states, may be deceived, while thinking that the broad wide expansions of the *appareil descendant* could be formed by the union of the portion of the

¹ 'Proceedings of the Imperial Academy of Sciences of Vienna,' vol. xi, pp. 991 and following, 1853.

² The words *appareil ascendant*, *appareil descendant*, *bride transversale*, &c., as used by M. E. Deslongchamps, have been explained in pp. 78 and 79 of the 'Introduction.' The ascending apparatus of *Thecidium* appeared to Mr. S. P. Woodward and myself to be nothing more than the equivalent of the "septum" of *Terebratella*, *Magas*, *Argiope*, &c.; the cirrated lip commences on the outer edge of the oral processes and is continued along the outer edge of the loop.

loop placed between the septa, but it will be sufficient to remind the reader, that it is the exterior margin of the loop-riband which becomes fixed to the valve, and that the outer margin must bear the cirri.

The *bridge* (Pl. VI, fig. 37, *w*, Int.) offers so many striking analogies with the "converging processes" near the crura of *Argiope*, that it appears impossible to seek a representation of these parts in any portion of the *appareil descendant*; so that while describing the *brachial* arrangement in *Thecidium digitatum* or *T. papillatum* (= *radians*, Def.), we should say, the *loop* is forced to form a curved line by the protrusion of the septa (as in *Argiope decollata*, &c.), the exterior side adhering wholly to the valve and septa (as it does partially so in *A. decollata*), while the converging processes are united, so as to form the *bridge*, the crura being likewise fixed to the valve. The *brachial membrane* is protected by peculiar calcareous *supra-membraneal deposits*, termed *appareil descendant* by M. E. Deslongchamps.¹

It seems, therefore, that M. Suess entirely objects to any portion of M. E. Deslongchamps' last-named *appareil* representing the *loop*; that in *Th. digitatum*, for example, all the branches or grooves are equal, while in *Th. papillatum* the outer branches of the *appareil descendant* are both larger and broader than the more central ones; but that in *Th. Mayale*, Desl., the *supra-membraneal disk* appears to be really wanting, while the equivalent of the loop may easily be recognised, forming a raised rim all round the septa. The last-named species would therefore approach nearer to *Argiope* than any other hitherto discovered, and might, perhaps, deserve to be considered as the type of a distinct *group* or *sub-section* of *THECIDIUM*; but M. Suess considers that before arriving positively at such a conclusion, additional researches will require to be made on *perfect* interiors of *Th. rusticum* (Moore), where no trace of *appareil descendant* has hitherto been observed.

The *supra-membraneal disk* is always fixed to the valve about the centre of the shell, on either side of the *inferior* part of the *visceral cavity*, but there exists much difference as to the extent to which the disk is fixed. In *Th. digitatum* and in *Th. sinuatum* it adheres throughout; the portion above the *visceral cavity* only remaining free.

After these and other preliminary observations, M. Suess enters into an elaborate description of the *Thecidium vermiculare*, Schl., sp. (= *Th. hippocrepis*, Goldfuss), and observes that in *Th. sinuatum* the portion of the *supra-membraneal disk* above the *visceral cavity* is not a solid calcareous mass, but a loose net-work fixed to a solid rim, termed the *bride transversale* by E. Deslongchamps. This remarkable and delicate net-work is beautifully exemplified in *Th. papillatum* (= *radians*), and still more widely open in *Th. vermiculare*. In *Th. digitatum* all the windings of the brachia are nearly on the same line or level ('Introd.,' Pl. VI, fig. 40²), while in *Th. papillatum* they rise from about the middle of the shell, and to such an altitude in *Th. vermiculare* as to stand nearly vertically to the direction of the valve.

Thus the characteristic peculiarity in the last-named *Thecidium*, and a few other allied species, consists in the elevation of this *supra-membraneal disk*; it does not become entirely free, but those portions which used to be formed of solid masses in other species, are here represented by thin, delicate net-works. In *Th. papillatum* we see contrary to what *Th. digitatum* shows, that all the branches of the loop and lobes to which they are united have a tendency to radiate from one central stem, somewhat similar to the branches

¹ Mr. S. P. Woodward describes the *disk* and *loop* as follows:—"Oral processes united, forming a bridge over the small and deep visceral cavity; disk grooved for the reception of the loop, the grooves separated by branches from a central septum; loop often unsymmetrical, lobed, and united more or less intimately with the sides of the grooves." ('Manual of the Mollusca,' part ii, p. 221, 1854.) M. Suess's views regarding the loop differ from those we advanced in 1852; but a further examination of the animal of the recent *Th. Mediterraneum* will be desirable, before this question can be finally settled. The cirrated margin being apparently attached to the inner sides of the sinuous grooves, in the specimen examined by Mr. Woodward and myself, in 1852, might perhaps favour M. Suess's opinion?

² I much regret not having been able to reproduce some of M. Suess's admirable illustrations, but I found that they could be but imperfectly represented by woodcuts.

of a tree. This is still more the case in *Th. vermiculare*, in which the central stem attains a high elevation, bearing all the other windings of the loop; in the last-named shell, the upright portion which covers the visceral cavity is perforated by numerous pores, between which excrescences are sometimes seen, and that these apertures were probably destined to allow a kind of current in the fluid filling the visceral cavity.¹

From these researches, it seems probable that the *Family* THECIDIIDÆ and *Sub-Family* STRINGOCEPHALIDÆ may be advantageously dispensed with, and their genera added to the great *Family* TEREBRATULIDÆ. This view, which has been adopted by Mr. S. P. Woodward, has likewise been my opinion for some time past, especially since the fortunate discoveries made by M. Suess. All that will be necessary is, therefore (in p. 51), to continue the connecting line from *Terebratula* down to *Thecidium*, and to erase the family and sub-family above mentioned.

Page 78.

It is observed, that the most ancient *Thecidium* then known to us, was that found in the Triassic beds of St. Cassian (Tyrol); but we subsequently read in the 'Bulletin de la Soc. Géol. de France' (vol. x, p. 248, 1853), that Count Keyserling had discovered among the Carboniferous Fossils from Sterlitamak, a shell, which he considers to belong to the genus *Thecidium*, and which he describes as follows:—"It is not new, being the *Anomia antiqua* of M'Coy;² but casts, partly deprived of shell, prove that it is a *Thecidium*, ornamented by concentric waves, as in *Th. tetragonum* (Roemer), of which one valve is attached and perforated, while the other equally inflated exhibits a digitated arrangement which occupies nearly all the interior. The oblique disposition of the processes of this arrangement (appareil) round the mesial crest, similar to the leaves of a fern round their stem, has suggested to me the denomination *Th. filicis* for the species. In analogous forms the digitations are directed forward, and more or less arched; a crenulated ridge following exteriorly all round the lateral digitated impressions, of which the second from the hinge is the largest." We are at a loss to understand this remarkable fossil, as we cannot perceive in the figure published by Professor M'Coy, any reason to believe that it belongs to *Thecidium*, and must therefore delay the admission of the genus into the Carboniferous age, until M. de Keyserling has given us some more tangible proof in the shape of illustration.

Family—SPIRIFERIDÆ.

Page 84, note 3.

Add—M. Suess objects to the term *ATHYRIS* being applied to such shells as *T. Herculea*, *T. tumida*, *T. scalprum*, &c.,³ that generic denomination having been originally employed by Professor M'Coy, for *T. concentrica*, *lamellosa*, and other similarly organised species; and that we cannot admit the new version proposed by the learned professor in his subsequent work on the 'British Palæozoic Fossils in the Cambridge Museum.' If the denomination *Athyris* is to be removed on philological grounds, M. Suess would adopt *SPIRIGERA*, D'Orbigny, for *T. concentrica*, &c.; and claims the priority of his genus *MERISTA*,⁴ for *M. Herculea*, *M. scalprum*, and other similar species. Mr. S. P. Woodward adopts *Athyris*, as originally defined (*A. concentrica*),⁵ and, the sub-genus *MERISTA*, Suess, for *T. Herculea*, *T. scalprum*, &c.

¹ M. Suess' speculation touching the use of the pores in the apparatus of *Thecidium vermiculare*, is perhaps hazardous.

² 'A Synopsis of the Characters of the Carboniferous Limestone Fossils of Ireland,' p. 87, pl. xix, fig. 7, 1844.

³ Suess, in p. 58, of Leonhard's 'Neuves Jahrbuch,' Jan., 1854.

⁴ Described by M. Suess, under that denomination, in the 'Jahrb. d. k. Geol. Reichs-Anstalt,' ii, iv, 150, 1851; and again mentioned in Leonhard's 'Neuves Jahrbuch,' p. 127, 1854.

⁵ 'Manual of the Mollusca,' part ii, p. 244, 1854.

Palæontologists therefore appear in general to agree, as to the propriety of placing in a separate group such organisations as *T. concentrica* on the one hand and *T. Herculea* on the other, but differ considerably as to the names to be adopted for each in particular. I am quite disposed to relinquish the proposition made in pp. 85 and 88. The matter may stand thus :

Page 87.

ATHYRIS, *M'Coy*, = (or) SPIRIGERA, *D'Orbigny*, for such shells as *A. concentrica*, *A. lamellosa*, *A. pectinifera*, *A. Roissyi*, &c.¹

Page 84.

For "ATHYRIS" = read "Sub-genus—MERISTA, *Suess*," for *T. Herculea*, *T. tumida*, *T. scalprum*, *T. cassidea* (Dal., sp.), &c., and

Page 88.

Sub-genus—RETZIA, *King*, for *T. Adrieni*, *T. ferita*, *T. serpentina*.

Page 89.

Genus—UNCITES, *Def.*²

¹ The arrangement of the *crural processes, attachment, and direction of the first spiral coils* in this, and in other species of the genus, ATHYRIS, *M'Coy* = SPIRIGERA, *D'Orb.*, has not as yet been completely understood, nor have the many efforts made in that direction both by Mr. S. P. Woodward and myself been attended with results which may be termed entirely satisfactory.

In the 'Manual of the Mollusca,' Mr. S. P. Woodward has represented what he supposes to be the probable arrangement, and states (p. 224), "*hinge plate with four muscular cavities, perforated by a small round foramen, and supporting a small complicated loop (?) between the spires; spires directed outwards, crura united by a prominent oral loop. The foramen in the hinge plate occupies the situation of the notch, through which the intestine passes in Rhynchonella.*" I cannot, however, at present, entirely coincide in the opinion expressed by my able and conscientious friend, not from any positive observations to the contrary, but because I am rather inclined to believe, that only one attachment took place from the base of the hinge plate (as in *Spirifer*), forming at the same time the spire and complicated crural process; or in other words, that the loop (?) described by Mr. Woodward is not independent of the crura and spiral appendages. I would therefore urge upon those naturalists who may possess specimens of *A. Roissyi* in a favorable condition for observation (as they do often occur near Tournay), to endeavour to clear up this unsettled, and important character of internal organisation.

² In p. 90, I quoted as examples, *Uncites Gryphus*, Schloth., and *U. lævis*, *M'Coy*; the last reference was given upon Professor *M'Coy's* authority, but I do not feel quite certain that *U. lævis* belongs to the genus, and according to Mr. Salter it would be the same as *Ter. porrecta*, Sow., 'Min. Con.,' tab. 576, fig. 1, which I believe to be a *Stringocephalus*. I also unintentionally omitted to observe in p. 89, that Professor *M'Coy's* views on this genus differ entirely from those advocated in the present volume; thus in p. 380 of the 'British Palæozoic Fossils' (1852), the genus UNCITES forms alone the

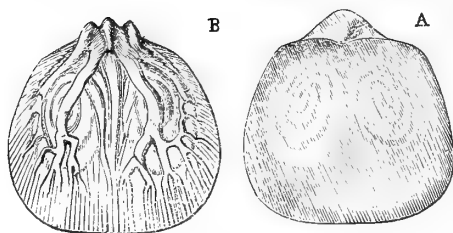
"*VIIth Family*—UNCITIDÆ of Professor *M'Coy*.

"Genus—UNCITES (*Defrance*), as here defined.

"Gen. Char. *Shell elongate-ovate, slightly inequilateral; substance very thick, densely fibrous; beak of the receiving valve very long, narrow, claw-shaped, gently incurved obliquely on one side; with a wide concave imperforate defined channel beneath, no internal septa, nor appendages in either valve.*"

Professor *M'Coy* also states, "*having first ascertained the true internal characters of that curious*

Page 92, Genus—KONINCKINA, Suess.



Koninckina Leonhardi.

- A. Translucent specimen.
B. Interior of the dorsal valve, showing remains of the vascular system.

With Mr. Woodward's permission, I here reproduce two additional figures, drawn from two specimens forming part of Klipstein's Collection, in the British Museum, and published in the 'Manual of the Mollusca,' part ii, p. 231, 1854.

Much doubt remains still, as to where this curious genus should be located; Mr. Woodward has placed it in the family ORTHIDÆ,? observing that, "this curious little shell most resembles the Triassic *Leptaena dubia* (*producta*), Münster (= *Crania Murchisoni*, Klipst.)!"

Family—STROPHOMENIDÆ.

Page 105, *Strophomena*.

In the 'Natural History of New York,' vol. ii, p. 63, 1852, Mr. J. Hall proposes to distinguish those *Strophomenas* which possess a denticulated hinge line by the generic appellation of *Stropheodonta* (Gr. *στροφεύς*, *cardo*, and *οδούς*, *dens*), naming as types *S. demissa*, Conrad, and *S. prisca*, Hall. I am not certain that this character can be considered of sufficient importance for the creation of a separate genus: *Strophomena euglypha*, *S. filosa*, and many other species admitted into *Strophomena*, possess denticulations only on those portions of the hinge line near the cardinal process, while the remaining portion is quite smooth.

Page 103.

Note 7 must be removed from ORTHIS, and placed under the Genus CHONETES (p. 113); and for (3d line) "and which I am inclined to believe belonged to a species of *Orthis*, bearing great resemblance to that form known by the name of *O. resupinata*, Martin, sp.," read "and which belong to *Chonetes comoides*, Sow., sp."

Obs. Having received from Mr. G. W. Ormerod the loan of several examples similar to (but more perfect than) those in the Society's collection, I at once discovered the mistake I had committed, since they evidently belong to *C. comoides*, Sow.; an opinion subsequently corroborated by M. L. de Koninck, Salter, and Woodward. In Appendix, pl. A, fig. 29, I have represented Mr. Ormerod's most complete example of the interior of the ventral valve, wherein the impressions left by the adductor (A) and cardinal muscles (C) are beautifully defined.¹

Eifel genus, it gives me much pleasure to recognise in our rocks a second species of this remarkable genus;" but I fear that the learned professor cannot have made himself perfectly acquainted with the internal characters of this *Eifel* genus, or he would have perceived that the shell was not totally deprived of appendages in either valve, since several examples of *U. Gryphus* have shown fragments of internal appendages, as represented in pl. vii, fig. 86, c; although only one has hitherto exhibited to my knowledge traces of the spirals discovered by Professor Beyrich.

As stated in p. 89 of the 'Introduction,' I feel impressed that the place of UNCITES is in the Family SPIRIFERIDÆ, a view sanctioned and adopted both by M. Suess and Mr. Woodward.

¹ In vol. x of the 'Quarterly Journal of the Geological Society' (p. 202, pl. viii, Dec., 1853), will be found recorded all I have hitherto been able to discover relative to this most interesting species.

Page 121.

I stated that the genus *CALCEOLA* was confined to the DEVONIAN epoch, and that I was acquainted with but one well-authenticated species. Dr. Fr. Roemer has, however, recently informed me that he has found a second species in true SILURIAN rocks, near Brownsport, in the State of Tennessee, N.A.¹

Pages 122, 124, and 125.

For "*Spondylobus*" read "*Spondylolobus*" (M'Coy).

Page 133.

Family—LINGULIDÆ.

Page 134.

Line 3, for "beak of the valve," read "beak of the *ventral* valve."

„ 10, for "left by the pedicle muscle (A)," read "left by the *post-adductor* muscle."

„ 13, for "caused by the posterior," read "caused by the anterior."

„ 16, after "last-described impressions," add "in the dorsal valve."

„ 17, for "combined extremities of the anterior pair," read "extremities of the anterior pair of retractor muscles."

The animal of *Lingula anatina* having been minutely examined by Mr. S. P. Woodward subsequently to the publication of my 'Introduction,' I am now enabled, with his kind permission, to reproduce the woodcuts and description recently published by that able naturalist, in the second portion of his excellent and valuable 'Manual of the Mollusca.'

¹ Note on *Calceola Tennesseensis*, n. sp., a true Silurian species of the genus (extracted from the unpublished manuscript of the 'Lethæa Geognostica, 1st Period,' by Fred. Roemer.

CALCEOLA TENNESSEENSIS, Fred. Roemer, n. sp.

Calceola sandalina, Froost. 'Fifth Report on the Geology of the State of Tennessee,' Nashville (p. 47, 1840). This species, although similar to *Calceola sandalina*, differs from the type of the genus by the following characters:

1. The shell is much thicker than in *C. sandalina*, and the space for the reception of the soft parts of the animal in consequence reduced to a shallow hole.

2. The edges separating the area of the larger valve from the convex posterior part of the valve are much less angular, or more rounded.

3. The area of the smaller valve, which in *C. sandalina* falls into the same plane, or nearly so, is inclined backwards, and forms an obtuse angle with that of the larger valve.

Locality. Not very rare in calcareous strata of the age of the Wenlock Limestone of England, associated with *Orthis elegantula*, *Caryocrinus ornatus*, *Pentatremites Reinwardtii*, &c.

Calceola pyramidalis, Girard (Leonh. and Bronn's 'Jahrb.,' 1842, p. 232, f. a, b, c), from the Silurian strata of Gothland, is not a Mollusc, but a Zoophyte, and synonymous with *Goniophyllum pyramidale*, Edwards and Haime, 'Archive du Mus.,' vol. v, p. 404 (Fr. Roemer).

Family—LINGULIDÆ.¹

“*Animal*. With a highly vascular mantle, fringed with horny setæ; oral arms thick, fleshy, spiral, the spires directed inwards, towards each other; valves opened and closed by sliding muscles.

“In fig. 1, a small portion of the liver and visceral sheath have been removed, to show the course of the

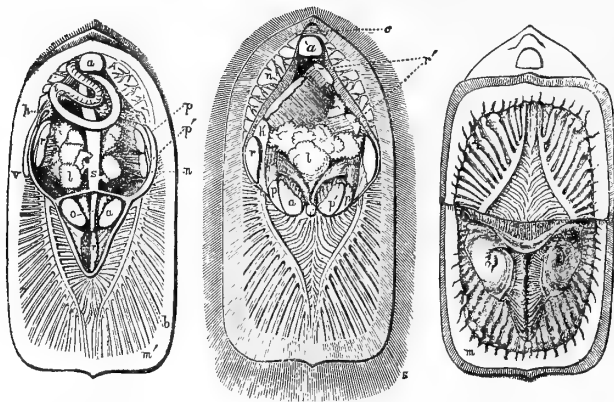


Fig. 1. Dorsal.

Fig. 2. Ventral.

Fig. 3. Ventral.

Lingula anatina, Lamarck.

a a, anterior adductors; a', posterior adductor; pp, external protractors; p' p', central protractors; rr, anterior retractors; r' r' r', posterior retractors; c, capsule of pedicle; nn, visceral sheath; o, œsophagus; s, stomach; l, liver; i, intestine; v, vent; h h, auricles; h', left ventricle; b, branchial vessels; m', mantle margin; m, inner lamina of mantle—margin retracted, showing bases of setæ; s, setæ.

stomach and intestine. In some specimens the whole of the viscera, except a portion of the liver, are concealed by the ovaries. In fig. 3, the front half of the ventral mantle-lobe is raised, to show the spiral arms: the black spot in the centre is the mouth, with its upper and lower lips, one fringed, the other plain. The mantle-fringe has been omitted in figs. 1 and 3.

“*Animal*. With the mantle-lobes firmly adhering to the shell, and united to the epidermis, their margins distinct, and fringed all round: branchial veins giving off numerous free, elongated, narrow loops from their inner surfaces; visceral cavity occupying the posterior half of the shell, and surrounded by a strong muscular sheath: pedicle elongated, thick: adductor muscles three, the posterior pair combined: two pairs of retractors, the posterior pair unsymmetrical, one of them

dividing: protractor sliding muscles two pairs: stomach long and straight, sustained by inflections of the visceral sheath: intestine convoluted dorsally, terminating between the mantle-lobes on the right side;

¹ ‘Manual of the Mollusca,’ part ii, p. 239, 1854, woodcuts Nos. 165, 166, 167.

The etymology of several of the generic appellations having been omitted in this volume, I here add them, from Mr. Woodward’s ‘Manual:’

TEREBRATULA. *Etym.*—diminutive of *terebratus*, perforated.

ARGIOPE. *Etym.*—*Argiope*, a nymph.

THECIDIUM. *Etym.*—*Thekidion*, a small pouch.

STRINGOCEPHALUS. *Etym.* *Strinx* (*Stringos*) an owl, *cephale*, the head.

ATHYRIS. *Etym.*—*A*, without, *thuris*, a door.

PENTAMERUS. *Etym.*—*Pentamerus*, five partite.

ORTHIS. *Etym.*—*Orthos*, straight.

STROPHOMENA. *Etym.*—*Strophos*, bent, *mene*, crescent.

CALCEOLA. *Etym.*—*Calceola*, a slipper.

CHONETES. *Etym.*—*Chone*, a cup.

CRANIA. *Etym.*—*Kraneia*, capitate.

SIPHONOTRETA. *Etym.*—*Siphon*, a tube, *tretos*, perforated.

LINGULA. *Etym.*—*Lingula*, a little tongue.

oral arms disposed in about six close whirls, their cavities opening into the prolongation of the visceral sheath in front of the adductors.¹

"Observations on the living *Lingula* are much wanted; the oral arms probably extended as far as the margins of the shell; and the pedicle, which is often nine inches long in preserved specimens, is doubtless much longer and contractile when alive. The shell is horny and flexible, and always of a greenish colour."

Mr. Salter has found that *Lingula Davisii* from the Lower Silurian of Tremadoc, has a pedicle groove, like *Obolus*, and that it might, perhaps, form a distinct section of *Lingula*. This will, however, require some further investigation.

Page 135.

In *Obolus* the hinge-margin is thickened inside, and slightly grooved in the ventral valve: posterior adductor (A) impressions separate: anterior pair (C) sub-central: impressions of sliding muscles (B) lateral, as shown by my woodcuts (p. 136). The pedicle scar in the centre of woodcut, fig. 54, has no letter.

Page 136.

Woodcut, fig. 51, for "from Ruma," read "from Russia."

PART I.

BRITISH TERTIARY BRACHIOPODA.

Since the publication of this Monograph, in 1852, no new species seems to have been discovered, but I am able to offer a few additional illustrations from more perfect individuals.

Page 5.

Lingula Dumortieri has been erroneously spelt *Dumontieri*, in pp. 4, 5, 6, and 9, (Mr. R. Ch. Dewael has defined the stratigraphical position of this species in the Antwerp Crag. 'Bull. Acad. Royal.' Belgium, 1853.)

¹ In p. 211, Mr. Woodward adds several interesting comparisons between the dispositions of the animal in *Lingula* and the other genera, and from which I have transcribed the following passages:

"On separating the valves of a recent *Terebratula*, the digestive organs and muscles are seen to occupy only a very small space near the beak of the shell, partitioned off from the general cavity by a strong membrane, in the centre of which is placed the animal's mouth. The large cavity is occupied by the fringed arms. . . . Their nature will be better understood by comparing them with the lips and labial tentacles of the ordinary bivalves; they are, in fact, lateral prolongations of the lips, supported on muscular stalks, and are so long as to require being folded or coiled up. In *Rhynchonella* and *Lingula* the arms are spiral and separate: in *Terebratula* and *Discina* they are only spiral at the tips, and are united together by a membrane, so as to form a lobed disk. . . . The mouth conducts by a narrow oesophagus to a simple stomach, which is surrounded by the large and granulated liver: the intestine of *Lingula* is reflected dorsally, slightly convoluted, and terminates between the mantle lobes on the right side. In *Discina* it is reflected vertically, and passes straight to the right, ending as in *Lingula*. In *Terebratula*, *Rhynchonella*, and probably all the normal Brachiopoda, the intestine is simple and reflected ventrally, passing through a notch or foramen in the hinge-plate, and ending behind the ventral insertion of the adductor muscle."

Page 6, *Lingula tenuis*, Sow.

From want of specimens I could not illustrate this species sufficiently in 1852, but now I am able to add several figures taken from the most perfect examples in the collection of Mr. Wetherell. See Appendix, Pl. A, figs. 3, 4, and 5.

Pages 6, 7, and 9.

For "ORBICULA," read "DISCINA."

Page 9.

Second line under the woodcut, for "on the anterior side," read "on the lower side."

Page 11.

Note 1, add, Mr. Barlee has taken them (*Argiope cistellula*) forty miles east of Zetland (Forbes and Hanley, 'British Mollusca,' Appendix, vol. iv, p. 257).

Page 16, *Terebratula cranium*.

Note 1. The illustration Pl. I, fig. 8*d*, was drawn from a very imperfect specimen, but I am now able to refigure the same valve (Pl. A, fig. 1), by which it will be seen that the species possessed an elongated loop, and consequently belongs to the *Section* WALDHEIMIA of King. Four examples of this rare species have lately been procured by Mr. Barlee, thirty miles east of Zetland (Forbes and Hanley, 'British Mollusca,' vol. iv, p. 257).

Page 19, *Ter. bisinuata*.

I have represented (Pl. A, fig. 2) the perfect example found by Mr. Cunningham, and mentioned in note 1, p. 19.

PART II.

MONOGRAPH OF CRETACEOUS SPECIES.

(In the concluding portion of this monograph, published in 1854, will be found most of the additions and corrections I have been able to introduce.)

Page 11.

Line 1, for "Egnabergensis" read "Ignabergensis."

„ 2, for "Numulo" read "Numulus minor," and for "Brattenbergensis" read "Brattenburgensis."

„ 14, for "Mondergattang" read "Mon der Gattung."

Page 15.

Line 11. Sig. Michelotti having obligingly sent me specimens of his *Th. Broderipii*, I was able to ascertain that they belong to *Thecidium Mediterraneum*. This species has also been discovered by Sir C. Lyell, in the *miocene* beds of the Canary Islands.

Page 23.

Line 19, *for* "Maudesly" *read* "Mundesly."

Page 26.

Line 32, *for* "Terebratella pectita (Brong.)," *read* "Terebratula pectita (Brong.)."

Page 27.

Line 1, *for* "1826 or 1827," *read* "1816 or 1817," *and erase the word* "TEREBRATELLA."

Page 51.

Line 10, *for* "Hornsey" *read* "Hamsey."

PART III.

OOLITIC AND LIASSIC SPECIES.

Since the publication of this monograph (1851-2) very few additional species seem to have been discovered; but certain points in connexion with those already described have received further elucidation.

As we progress with the minute investigation, and collecting of species from each bed or layer, it always becomes the more evident that we are still far from having attained a complete knowledge of the exact period when certain forms first appeared, their duration, and the epoch at which they became extinct. This most desirable and important knowledge cannot be obtained by a few excursions, nor in a short space of time: it is the reward which will attend those indefatigable *local geologists* who, like Mr. Moore, Dr. Wright, and others, assiduously explore every inch of the beds situated within the district they inhabit, and who scrupulously assemble and correctly determine all the fossil contents of *each bed in succession*. It is also of the utmost importance to examine, record, and illustrate the numberless variations due to age, race, local condition, and malformation, presented by the individuals of each species, living congregated or disseminated in the same bed and in different localities, that we may obtain a just clue to our appreciation of the characters and limits to be assigned to *our* species, often too arbitrarily circumscribed.¹

It is not difficult to say, for example, that the *Terebratula ornithocephala*, *T. digona*, *T. obovata*, and other species of authors, *are all referable to one species*, and that most species *are derivative* of others; such

¹ Mr. Woodward states that "some of the *Brachiopoda* appear to attain their full growth in a single season, and all, probably, live many years after becoming adult. The growth of the valves takes place chiefly at the margin: adult shells are more globular than the young, and aged specimens still more so. The shell is also thickened by the deposit of internal layers, which sometimes entirely fill the beak and every portion of the cavity of the interior which is not occupied by the animal, suggesting the notion that the creature must have died from the plethoric exercise of the calcifying function converting its shell into a mausoleum, like many of the Ascidian zoophytes." ('Manual of the Mollusca,' part ii, p. 213, 1854.)

assertions only shew the limited experience of those who make them: nor is it sufficient to state that such and such a form *is a derivative*, except we can demonstrate the source whence the form *has been derived*, and explain, both by words and figure, wherein the *natural* connexion or sequence lies. But let it not be imagined, from what has just been stated, that it is my wish or intention to deny that some of the *so-termed* species enumerated in this monograph are in reality more than simple variations, referable to one single type. In many instances I have expressed doubts as to their distinct specific claims; and if I did not combine certain forms, it was because the material *then* at my disposal was not sufficient to warrant such a conclusion.

There is also another point no less worthy of investigation, viz., *what relative value or importance should we attach to the minor local divisions in the strata made use of in geological works?* Professor Forbes states¹ that "the marine faunas of the oolitic epoch indicate at least three great and widely spread assemblages of types, each exhibiting a general and easily recognisable facies. These aspects may be termed respectively the *liassic*, the *Bathonian*, and the *Oxfordian*; the two latter terms being used for want of better, and being adopted in a wide and general sense, and not in the restricted meaning in which they are used by M. A. d'Orbigny. The horizon of change of facies at the boundary between each is a horizon, to a considerable extent, of change of species. I believe that every year's research will make it more evident that the perishing of species is simply the result of the influence of physical changes in specific areas, and depends upon no law of inherent limitation of power to extent in time. If so, we should expect to find indications of the cause of the greater changes in the oolitic and marine fauna in the shape of strata bearing evidence of a wide-spread change of physical conditions within the great oolitic area. An extensive change of species within a marine area in all likelihood is dependent on an extensive conversion of that area into terrestrial surface."

The questions relating to the existence of species in time, as well as of the cause of their sudden disappearance, and replacement by others, are among the most important inquiries within the domain of palæontology, and have of late years particularly occupied the thoughts of several of our most distinguished foreign and British naturalists.

M. Barrande informs us,² that his views on this subject differ materially from those recently circulated by several illustrious men in their most recently published elementary works. According to which doctrines, *the different animal creations characterising the vertical sequence of formations (Terrains) have been suddenly destroyed by violent convulsions of the earth's surface (cataclysmes), annihilating at once all the then existing animal creation: so that each of these universal revolutions (according to their theory) would explain, in a very plausible manner, the complete renewal at different periods of all the animal forms on the surface of the globe.* M. Barrande admits that this renewal in many cases cannot be contested; but asserts that the change is not in all instances due to convulsions of the earth's surface, of which he quotes several remarkable examples among the Palæozoic deposits. It seems to him more rational to admit that the phenomena of the development of the series of beings in time, taken as a whole, is subjected to a special law of nature, independent of that which governs the physical revolutions of the surface of our planet; that since we see all these faunas disappear in succession, one after the other, from the entire surface of the globe, at defined and limited periods, never to be reproduced under the same aspect, one is tempted to believe that the same creative cause which has restricted in so abrupt a manner the existence of individuals, *has likewise imparted only a determined quantity of vital force to all the families of animals, and, consequently, to each of the creations* destined to occupy in succession the surface of our globe.

¹ 'Quarterly Journal of the Geol. Soc.,' vol. x, No. 38, 1854. Professor Forbes is referring to Professor Morris's 'Researches in Lincolnshire,' published in vol. ix, p. 317, 1853, of the same journal. See also Davidson, 'Bull. Soc. Geol., France,' second series, t. xi, p. 171, Jan. 16, 1854.

² 'Bulletin de la Société Geol. de France,' vol. x, p. 415, May, 1853; and 'Système Silurien de la Russie,' vol. i. See also Barrande, 'Bull. Soc. Geol. France,' vol. xi, second series, p. 311, 1844.

Similar opinions have also been ably advocated by Viscount d'Archiac, in his most recent publications¹; and I feel convinced that, as we progress in our examination of the organic world, we will perceive the absolute necessity of seeking some other explanation for the successive replacements, than that attributable to partial convulsions, upheaval of mountains, or limited unconformity of stratification.

M. d'Orbigny's researches have been principally directed to the study of the Mesozoic and Tertiary formations, as seen in France, which has led him to divide that extensive period into twenty-one distinct epochs; each (in his opinion) characterised by a complete or almost entire change in the animal creation; while during the much more extended Palæozoic period he only sees reason for admitting four. Convinced that such is the unvaried law of nature, and that matters will so remain, he proposes to designate each of these successive creations by a distinct and defined number; thus, were we alluding to the epoch of the Gault, we might simply say, nineteenth age. The whole Silurian period would be No. 1; the Devonian, No. 2; and so on until we reach the Jurassic and Cretaceous periods, wherein the succession of successive changes would have been so rapid, that in the first he admits ten, and in the second seven, each according to his system, having as much value, or being as entirely independent, as the whole Silurian, Devonian, or Carboniferous periods, Nos. 1, 2, and 3!

That such a system was, to say the least, hazardous, becomes each day the more apparent: has not M. Barrande already shown that the Silurian age in Bohemia, as well as in many other countries, are susceptible of being separated into three distinct natural divisions; each (so far as his researches extend) possessing a distinct animal creation, which he designates as *faunes primordiale, seconde, and troisieme*, and with equal, if not greater, claims to count as 1, 2 and 3, as M. d'Orbigny's Jurassic age has to Nos. 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16?

It would, therefore, follow that if M. d'Orbigny's newly proposed practice were admitted, viz., that of designating a distinct creation or epoch by the simple mention of the number he has imposed, M. Barrande's numeration would essentially differ from that adopted by the author of the 'Palæontologie Française.' Such a system, leading at once to the most pernicious results, cannot be too strongly opposed at its very birth, as all mistaken views, if allowed to take root, are infinitely more difficult to remove after they have become familiarised by habit. Besides which, the real value of several of these divisions are, in many cases, *more than problematical*,² and in my opinion, as well as in that of other palæontologists, it is very probable that it may soon be found absolutely necessary to restrict considerably the number of the *distinct creations* introduced into the Mesozoic and Tertiary periods.

We will now revert to some of the species in the order in which they have been published:

Page 8, LINGULA.

Besides *Ling. Beanii*, Phil., and *L. ovalis*, Sow., several doubtful specimens have been forwarded for examination, but not perfect enough to warrant an accurate identification.

¹ 'Histoire des Progrès de la Géologie,' vol. iv, pp. 2 and 3, and vol. v, 'Introduction,' pl. 6 to 12, 1853; also, 'Bulletin de la Soc. Geol. de France,' vol. x, p. 423, 1853. I would strongly urge the importance of every geologist and palæontologist becoming acquainted with the observations published by this celebrated author.

² In a very interesting memoir, published by Mr. L. Saemann, in the 'Bull. Soc. Geol. de France,' vol. xi, second series, p. 261, 1854, an attempt has been made to place in comparison and parallelism the different British subdivisions of our *lias*, *inferior oolite*, and *great oolite*, with some of their equivalents in France and Germany. The table is good and useful, as it settles some of the much-vexed questions relating to the comparative age of many of the continental beds.

Page 9, DISCINA.

Four species have been described under the generic appellation of ORBICULA, which, as stated in the general introduction, must be changed to that of DISCINA: *Orbicula* being a synonym for CRANIA.

Discina Townshendi, Forbes.

Every exertion has been made to discover the exact age of the bed and locality from which this magnificent species or specimen was obtained; in page 9, it was erroneously supposed from the Oxford Clay, but I subsequently became convinced that its real age was that of the Lias, and marked it such in the general table, p. 98. Mr. Walton was informed that the shell was obtained by Townshend from the lias of Fretherne Cliff, on the banks of the Avon, near Newnham (Gloucestershire), and the Rev. P. B. Brodie states he has seen two other examples in a collection near that locality. *Discina Babeana* (D'Orbigny) is likewise from the Lias, and has attained similar dimensions; and it is possible that both this and *D. Townshendi* may require to be united, although all the French examples I have been able to examine were very much more convex or inflated.

Page 10, *Discina reflexa*, Sow.

Mr. Moore has lately discovered a small oval *Discina* in the Upper Lias, near Ilminster, which I am inclined to believe belongs to the present species; it measures—length 4, width 3, depth 1 line.

Page 12, THECIDIUM.

To the list of 'British Jurassic Thecidia,' Mr. Moore will perhaps be able to add two or three additional species: I shall at present only mention —

THECIDIUM DESLONGCHAMPSII, *Dav.* Appendix, Plate A, figs. 6, 6^{a b c}.

THECIDEA DESLONGCHAMPSII, *Dav.* Annals and Mag. of Nat. Hist., vol. ix, 2d ser., p. 258, pl. xiii, figs. 6—9, 1852.

— — *E. Deslongchamps.* Mémoires de la Soc. Linnéenne de Normandie, vol. ix, pl. xiii, fig. 26, 1853.

Diagnosis. Shell inequivalve, longer than wide, irregularly oblong: fixed to submarine objects by the flattened beak of the larger valve, moulding itself on the object to which it is attached, the remaining portion of the valve is regularly convex, and deepest near the hinge: area short, wide, and irregular: deltidium visible, but not sharply defined: *dorsal* valve as wide as long, operculiform, slightly convex and flattened: surface smooth, interrupted only by a few concentric lines of growth: structure punctated: hinge-line straight, valves articulating by means of two teeth in the larger valve and corresponding sockets in the smaller one. In the interior of the dental valve, beneath the deltidium, three short lamellar processes are seen to occupy about a fifth of the length of the shell; the central one being the longest and most elevated; the other two, appearing at the base of the dental plates, converge gradually towards the central one: a longitudinal rounded elevation extends also along the middle of the valve. In the interior of the smaller valve, on either side of the sockets, a wide, thickened, raised, granulated margin surrounds the shell, which, on reaching the middle of the front, directs itself longitudinally inwards under the form of a narrow, acute elevated crest, and not much longer than half the length of the valve; on either side of this ridge and the inner edge of the margin, are seen two other slender rounded ridges, covered with large granulations. Dimensions variable: length $1\frac{1}{2}$, width $1\frac{1}{3}$, depth $\frac{2}{3}$ line.

Obs. The discovery of this shell in the *Leptaena* bed of Ilminster, is entirely due to Mr. Moore's

continued and successful researches. The species was first described and figured by myself from the Upper Lias of May, near Caen, and subsequently again by M. Eugene Deslongchamps. In external shape, it reminds us of several Cretaceous *Thecidiidae*, such as *Th. tetragonum*, Roemer, *Th. rugosum*, D'Orb., &c., but is distinct from either, by the more simple internal arrangements of the smaller valve, where none of those numerous sinuated ridges exist; and it is certain, from the recent discoveries made, both by MM. Suess and Deslongchamps, that this and other Liasic *Thecidiidae* possessed a more complicated internal structure than that exhibited in the generality of specimens in which many delicate portions are destroyed.

Pl. A., fig. 6. A specimen from the Leptæna bed, near Ilminster. 6 ^{a, b, c.} enlarged representations.

Mr. C. Moore has also discovered three or four species of *Thecidium* in the sands of the Inferior Oolite at Dundry.

Page 16, LEPTÆNA.

Since the publication of the first Liasic species, many beautiful examples have been discovered in other localities. In 1847, the only form known on the Continent was *Lept. Liasiana* (Bouchard), from the Pic de Saint Loup; but since then the same shell has been found at May, in Normandy, along with *Lept. Bouchardii* and *L. Davidsoni*.¹ Besides the above-named species, Dr. Perier and E. Deslongchamps have also had the good fortune to find in the Lias of Curcy, near Caen, our *Leptæna Moorei*; there, as well as at Ilminster, associated with *Ter. globulina* and *Rh. pygmaea*.

Page 18, *Leptæna Liasiana*, Bouch.

This species seems to have made its first appearance in the salt marls or Triassic beds of St. Cassian, as may be seen from a series of specimens, forming part of Dr. Klipstein's figured collection, now in the British Museum; the identity of these examples with the French and British specimens was first suspected by Mr. S. P. Woodward. It is *Leptæna* (producta) *dubia* of Münster, and exhibits the small double area, minute circular foramen, and wide-thickened internal border, common to that species.

Page 17.

Leptæna Pearcei must be expunged, as the shell in question would belong, according to Mr. Moore, to the Lamellibranch genus *Monotis*. At the time of its publication, I had not been able to examine the interior, and the exterior of only one valve and specimen. I feel certain only of the following British species: *Lept. Moorei*, Dav., *L. Bouchardii*, Dav., and *L. Liasiana*, Bouchard.

Page 26, SPIRIFER.

Several minute specimens of *Spirifer* have been obtained from the *Leptæna* bed near Ilminster, by Mr. Moore; the largest measuring from half a line to one and a quarter line in length; and by from one to one and a half line in width. These microscopic Spirifers may perhaps prove to be nothing more than young states of *Spirifer Münsteri*; which they approach in shape (but not in dimensions) to that variety named *Austriaca* by M. Suess. On either side of a comparatively large mesial plait or fold, we find two or three lateral ones only; but it is well known that, with age, the number of ribs augment in many species. The subject will, however, demand further examination.

Mr. C. Moore has also lately discovered a small species of *Spirifer* (*Sp. Liasiana*, Moore, MS.) in the sands of the infer. oolite, at Dundry.

¹ Refer to M. E. Deslongchamps' 'Mémoire sur les Genres Leptæna et Thecidea des Terrains Jurassiques du Calvados,' 'Mémoires de la Société Linnéenne de Normandie,' vol. ix, 1853; and to a memoir in the 'Annuaire de l'Institut des Provinces' for 1854.

Page 26, *TEREBRATULA*.

The *Terebratulæ* hitherto discovered in our *British Jurassic beds* may be arranged into two, or perhaps three sections of that great genus, viz., *Terebratula* (proper), or those species provided with a short loop, and of which *Ter. maxillata*, Sow. = (*T. minor subrubra*, Llhwyd, 1699), may serve as the fossil type.

Secondly, into the section *Waldheimia* of King, which includes those *Terebratulæ* possessed of a lengthened loop, and more or less developed mesial septum in the dorsal or socket valve. *W. ornithocephala* and *W. digona*, Sow., sp., may be quoted as examples.

Of the third section *TEREBRATELLA*, I am not positively certain that any species occur in the Oolites; *T. hemispherica* (Sow.) having been there located entirely on M. d'Orbigny's authority, as all my attempts to discover the loop have proved unsuccessful from the want of a sufficient number of examples to sacrifice to that object. It would be very desirable to ascertain whether this section be really represented in our British Jurassic Fauna, and I trust the investigation will be continued on the first favorable opportunity.

I fully admit having been greatly puzzled how to deal with many of the numberless varieties which continually present themselves, in almost every species; and have very probably now and then retained under separate denominations forms which should have been united; but although I did not possess, at the time, those connecting links which would have warranted such a union, I did attempt, in pp. 27 and 28, to unite by a line several of those forms which seemed to me more closely allied, such as *T. quadrifida* and *T. cornuta*; *T. resupinata* and *T. Moorei*; *T. ornithocephala*, *T. lagenalis*, and *T. sublagenalis*; *T. punctata*, *T. subpunctata*, and *T. indentata*; *T. perovalis* and *T. intermedia*, &c.

It has been subsequently found that some of these names may be advantageously expunged; but the question to exactly define what should be united and what separated, is not always so easy to establish as many might imagine whose researches have been limited to a comparatively small number of individuals.

In our retrospect view of the species published in this Monograph, we may begin by remarking that, however nearly two forms may resemble each other externally, if the one possess a short loop and the other an elongated one, they cannot be united, or considered as varieties of the same species, from *zoological considerations* already detailed. Several questions having been repeatedly addressed to me, I will now endeavour to answer them to the best of my ability.

Page 28, *Ter. quadrifida* and *Ter. cornuta*

May belong to one single species, but I cannot add further details to those stated in p. 29.

Page 36, *T. numismalis*, Lamarck, and var. *subnumismalis*.

I am quite disposed to cancel my named variety; but I should hesitate before admitting that *T. numismalis* and *T. quadrifida* are varieties of a single species.

Page 31, *Ter. Waterhousii*, Dav., 1851.

M. Albert Oppel has recently described and figured what I take to be my species, under the new appellation of *T. subdigona*. ('Mittl. Lias Schwabens Steitt.,' 1853, tab. iv, fig. 2.)

Page 31, *Ter. resupinata*, Sow., 1812, and *T. Moorei*.

The passages connecting the extremes of these two forms are so numerous, that it will be necessary to consider the last simply as an inflated variety of *T. resupinata*, Sow.; but I believe *T. carinata* of Lamarck well distinguished by the shape of its beak and foramen.

T. impressa, *T. Bakeriæ*, *T. emarginata*, and *T. Waltoni* are all allied forms, but my observations have not yet warranted the propriety of merging them in *T. carinata*.

Page 38, *Ter. Bakeriæ*.

It is probable that *T. Heysiana* of W. Dunker and Meyer, published in the same year as this monograph, may belong to the same species. (See 'Palæontographica Beitrage Natur. der Vorwelt,' pl. xviii, fig. 5, 1851.)

Page 40, *Ter. ornithocephala*, Sow., *T. lagenalis*, and *T. sub-lagenalis*.

I entirely agree with Professor Buckmann, that the three shapes above mentioned, belong to a single species; and as Sowerby's name is the oldest, it should be the only one preserved; a similar opinion has been already expressed by several authors, among whom we may again mention Professor Bronn, nor was I far from admitting the fact in 1851, but must beg leave to dissent from the learned professor of the Cirencester Agricultural College, in his assertion that *T. digona* and *T. obovata* are nothing more than forms or varieties of *T. ornithocephala*.¹ Few authors would sanction such a combination, and I may here add the observations communicated to me on this subject, by the Rev. A. W. Griesbach, whose long residence in a Cornbrash district, and whose experience is worthy of respect. "Long before Professor Buckmann published his paper, I had come to the conclusion that *T. ornithocephala*, *T. lagenalis*, and *T. sub-lagenalis* are only forms of the same species; I have had several hundred specimens, and it is impossible to say of very many of them, that they belong to one type more than another. They flow into each other by such gentle gradations that the conclusion I refer to is unavoidable."

"As to *Ter. obovata* being the same species also, I do not think it can be borne out. I have multitudes of specimens, or have had, and yet there can be no doubt, even at a glance, that *T. obovata* is *obovata*, and not either of the other three forms. *T. digona* has certain well-defined characteristic marks, which *when well known*, will enable any one at once to distinguish it from *T. obovata*, some forms of which, however, closely resemble *T. digona*. I believe it to be a thorough good species, as most other people do."²

Page 39, *Ter. obovata*.

A single specimen of this species (agreeing in size and characters with those figured from the Cornbrash of Rushden), has been discovered in the *Coral Rag* of Malton (Yorkshire), by Mr. Ed. Barton, this fact was first brought to my notice by the Rev. A. W. Griesbach, and I have to express my obligations to Mr. Barton for the communication of the specimen.

Page 43, *Ter. cardium*, Lamarck.

I am informed by the Rev. A. W. Griesbach, that he has discovered a single specimen of this species in the *Cornbrash* of Rushden.

¹ On the Cornbrash of the Neighbourhood of Cirencester, 'Annals and Mag. of Nat. Hist.,' vol. x, 2d ser., p. 262, 1853.

² I much regret that Prof. Buckmann did not publish the names of the *seven* Cornbrash distinct species of Brachiopoda with which he states he is acquainted, from the neighbourhood of Cirencester.

Terebratulæ with Short Loops—TEREBRATULA Type.

Page 45, *Ter. punctata*, Sow. sp., *T. sub-punctata*, and *T. indentata*.

I am now ready to admit with Mr. J. Jones, of Gloucester, that *T. sub-punctata* is only the adult state of *T. punctata*, Sow., but am not yet prepared to say as much of *T. Edwardsii*. A dark longitudinal line visible on the surface of the ventral valve, in several examples communicated by Mr. Moore, indicating the presence of a mesial septum, led me to believe that this species was possessed of a lengthened loop, while in *T. punctata*, Sow., I am certain that the loop was short. I will not, however, pretend that I may not be mistaken relative to *T. Edwardsii*, it is a subject for further consideration. *T. indentata* may, perhaps, prove to be nothing more than a variety of *T. punctata*, but I have never had at my disposal a sufficient number of examples of the last to be able to decide the question.

Page 48, *Ter. simplex*, Buckman, 1845.

I am reminded by Dr. Wright, that Lillwhyd had named and figured the present shell under the appellation of *Terebratula triangularis maxima* ('Lith. Brit.,' 2d ed., 1699, p. 25, No. 870, tab. xxv, fig. 870). I believe it is a very good species, and quite distinct from *T. perovalis*, Sow.

Page 51 and 52, *Ter. perovalis* and *Ter. intermedia*, Sow.

Professor Buckman states that "*Ter. intermedia* is undoubtedly, to say the least, a form of *T. perovalis*." When describing *T. intermedia*, from the Cornbrash, I admitted that specimens of the last bore much resemblance to certain forms of *T. perovalis*; but I do not feel so confident as Mr. Buckmann seems to be, as to the propriety of at present uniting the two under a single denomination. The Rev. A. W. Griesbach states that, "there is, perhaps, more difficulty in speaking positively about *T. perovalis* and *T. intermedia*. The difficulty of discrimination can only take place, when we have nothing before us but half-grown specimens of *T. perovalis*; when this species attains its full development, as it does in the Inferior Oolite of Crickley Hill in Gloucestershire, Dundry, Yeovil, Les Moutiers (France), &c., there can be no doubt about it. So far as my experience goes of *T. intermedia*, and it has been very extensive (I possess a large series of adult typical forms, both from the Cornbrash and Great Oolite), and have never seen it lose the plication in the frontal margin and assume the form of the same margin, as seen in old specimens of *T. perovalis* from Crickley, I therefore conclude *T. perovalis* and *T. intermedia* to be distinct forms.

Professor Bayle informs me, that from the material in the School of Mines of Paris, it is impossible to distinguish young specimens of *T. intermedia*, *T. maxillata*, and *T. Phillipsii*, but admits that we can easily recognise adult types of the three species,¹ an opinion with which I entirely concur, as it is evident that the adult or full-grown state must give the character to the species, and not those intermediate conditions, wherein the animal has not attained its full development. No one (I suppose) would think of drawing up the characters of a species of Trilobite, from the appearance of one of its metamorphoses. It

¹ "Je reconnais, comme vous, qu'on peut trouver trois types bien distincts pour y rapporter ces trois espèces; mais dans les âges intermédiaires, il y a véritablement impossibilité absolue à faire rentrer la plupart des individus dans l'un plutôt que dans l'autre des trois types: mais comme la détermination d'une espèce exige toujours la connaissance précise de son développement, s'il y a trois types adultes, il y a trois espèces, quoiqu'il ne soit pas possible de déterminer avec certitude les jeunes." (Paris, 16 Juillet, 1854.)

is not only the young of the above-named Brachiopoda that cannot be always identified, but likewise those of most animals?

A specimen of *T. perovalis*, from Yeovil, in the Bristol Institution Museum, measures, length 3 inches, width $2\frac{1}{2}$ inches, depth 1 inch 10 lines; it is the largest British example which has come under my notice. I may say the same relative to the specimen of *T. Phillipsii*, represented in Appendix, Pl. A, fig. 14.

Page 51, *Ter. maxillata*, var. *sub-maxillata*.

In Pl. A, fig. 19, I have figured what I take to be a young individual of the var. *T. sub-maxillata*; it and many other similar specimens, present much outward resemblance to *Ter. pentaedra* of Münster, from the Coral Rag of Muggendorf (Bavaria), as seen in the British Museum. Mr. Lycett, who lives at the locality where the specimens above mentioned occur, favours the opinion I have taken; and states the var. *sub-maxillata* to be found in a bed of soft *Inferior Oolite Marl*, which is situated in the upper part of the Middle Freestone Division of that formation, and lower than the bed with *T. globata*.

Page 55, *Terebratula pygmaea*.

Belongs to the genus *Rhynchonella*, it must therefore, henceforth, be termed *Rhynchonella pygmaea*, Morris, sp.

Page 58, *Ter. Bentleyi*, Morris.

In place of the first two lines of the observations, read—"This is a very remarkable species, not hitherto described, but found by the Rev. A. Griesbach in the Cornbrash of Rushden." It was by mistake that the word "Wollaston" has been introduced, as I am informed by the Rev. A. W. Griesbach that the *Cornbrash* does not exist there, and only appears at two or three miles distance. Rushden is the locality from which the specimen (Pl. XIII, fig. 9) was obtained. Mr. Morris mentions it from Bourn; and Mr. Carter has some examples said to be from the vicinity of Stilton. It does not appear to be rare in Germany, but the specimens I have seen were smaller than our British ones.

Page 59, *Ter. sub-Bentleyi*.

In Pl. A, fig. 15, I have represented the only perfect individual at present known of this remarkable shell, and which was kindly forwarded for examination and publication by Prof. Sedgwick; it belongs to the Cambridge University Museum, and was derived from the soft inferior Oolitic Marl situated in the upper part of the middle freestone division, at Brimscombe, near Minchinhampton.¹ Detached ventral or dental valves have been now and then discovered. Dr. Wright possesses a specimen from the inferior oolite of Nailsworth, Gloucestershire. The custom of placing a *sub* before the name of a person, town, or county is so very objectionable and incorrect, that I am willing to exchange the denomination *sub-Bentleyi* for that of *Ter. galeiformis*—a MS. name given by Prof. M'Coy to this species.

¹ On the label is written, *Great Oolite*. Mr. Lycett informs me that this is a mistake, as no example has been found in that deposit.

ADDITIONAL SPECIES.

TEREBRATULA ETHERIDGII, Dav. Appendix, Pl. A, fig. 7—8.

Diagnosis. Shell inequivalve, almost as wide as long, and more or less obtusely five-sided. The *dorsal valve* is moderately convex at the umbo; but thence it forms a nearly straight mesial line to the front, in the approximation of which the lateral portions of the valve become much excavated, producing a mesial fold of moderate dimensions. The *ventral* or dental valve presents a longitudinal sinus, commencing towards the middle of the shell and extending to the front, the margin forming a convex curve, indenting considerably that of the opposite valve; lateral margins very flexuous; beak short, incurved, and truncated by a foramen of moderate dimensions, placed contiguous to the hinge-line and umbone of the socket valve. External surface smooth, marked only by a few concentric lines of growth. Loop unknown, but probably short. Dimensions variable: length, 13 lines; width, $12\frac{1}{2}$ lines; depth, 8 lines.

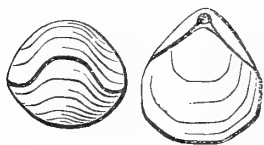
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Obs. Four examples of this shell are preserved in the Bristol Institution Museum, labelled “Dundry” (probably Inf. Oolite?), they differ from the Jurassic Terebratulæ described in this work by the shape and character of their mesial fold.

I have named it after Mr. Etheridge, to whom I feel greatly indebted for the liberal communication of a great number of interesting specimens belonging to the Bristol Institution Museum.

Plate A, fig. 8—9. Two examples from Dundry, in the Bristol Institution Museum.

Several examples of a *Terebratula* intermediate in shape and character between *Ter. Etheridgii* and *T. equestris* (Pl. A, fig. 7 and 9) have been lately discovered by Dr. Wright, in the *Perna bed* (top stratum of the Inf. Oolite), at Cold Comfort, eight miles from Cheltenham, or in that zone characterised by the *Trigonia costata*, *Cueullae ornata*, *Arca elegans*, *Myopsis rotunda*, *Ammonites Parkinsoni*, &c. In shape it is longer than wide; valves equally globose, with the greatest depth near the centre of the shell; margins sinuous, front nearly straight and angularly elevated; beak short, incurved; foramen small, circular, and separated from the hinge-line by a deltidium in two pieces; surface smooth, with obscure lines of growth. Average dimensions: length, $8\frac{1}{2}$ lines; width, $7\frac{1}{2}$ lines; depth, 6 lines. These specimens have been minutely examined by Dr. Wright, Mr. Lycett, and Mr. S. P. Woodward, and pronounced different from those hitherto described from our British Oolites. Should this shell turn out to be really new, and distinct from *T. Etheridgii* and *T. equestris*, as it is believed to be by the above-mentioned gentlemen, I should propose for it the name of its discoverer. It must likewise be mentioned that a shell bearing some resemblance to the one under descrip-



tion has been discovered by Mr. Lycett in the marl bed of the Inf. Oolite near Minchinhampton.

In Pl. A, fig. 9, will be found represented a terebratula, labelled “Fullers Earth, Grip Wood,” by Dr. W. Smith, and now in the British Museum. Mr. Woodward seems doubtful both as to the locality and stratum, and thinks that it may perhaps represent *Ter. equestris*, D’Orb. (‘Prodrome,’ vol. II, p. 24, 1850?); but, as the French author’s species is simply mentioned, without sufficient description or figure, all I can do at present is to point out the existence of the specimen, and recommend further researches to be made in Smith’s locality.

I have likewise represented in Pl. A, figs. 10 to 13, a series of specimens forwarded from the Bristol Institution Museum, with the sole indication, “Dundry.” They may, perhaps, only constitute a variety of *Ter. sphaeroidalis*?, but possess certain peculiarities not known to me in that species. I have figured several of the specimens, in the hopes that some positive information as to its strata and locality may be obtained.

RHYNCHONELLA.

I have little to add regarding the species belonging to this genus, although several alterations will probably be required as we progress in the knowledge of the variations peculiar to each of the species.

Page 69, *Rhynchonella Wrightii*, Dav.

In 1852 a single example of this remarkable species had been discovered; but since then three more have been collected by Dr. Wright, one of which I have represented in Pl. A, fig. 17; and among several *Terebratulæ* found by M. L. Saemann, in the Inf. Oolite of the Department de la Sarthe (France), I was glad to recognise our British species.

Page 90, *Rhynchonella obsoleta*, Sow.

During an investigation of the Linnean Collection on the 15th of August, 1853, Mr. Salter and myself came to the conclusion that this is the shell to which Linnæus had applied the name *Anomia farcta*. His original specimens, (as seen in box 199 of that Collection), were no doubt procured from England, and agree with his description of the species. The oldest name for this shell would therefore be *Rh. farcta*, Linn. Sp. ('Systema Naturæ,' 12th ed., vol. vii, p. 163, 1768); but, as Sowerby's denomination is completely familiarised by constant use, I do not think it would be serving science to restore the Linnean appellation.

Page 92, *Rh. Morièri*, Dav.,

May perhaps be nothing more than a variety of *R. obsoleta*.

Page 93, *Rh. tetrahedra*, Sow.

It has been found necessary to remove from this species the specimen Pl. XVIII, fig. 10, which has been considered the type of our *Rh. sub-decorata*.

Page 97, *Rh. Hopkinsi*, M'Coy.

In Pl. A, figs. 20 and 21, I have represented two of the four examples preserved in the Cambridge Woodwardian Museum, and stated to be from the Great Oolite of Minchinhampton. Professor Sedgwick believes them to be from that locality, although not of his own collecting; but it would appear almost certain that the shells in question are in reality not British, and that they were derived from the Great Oolite of Marquise, near Boulogne-sur-Mer (France),—an opinion entertained both by Mr. Bouchard and Mr. Lycett. The last-named gentleman has never seen a trace of such a shell in the oolites of Gloucestershire; it will, therefore, be necessary (until further proof) to remove *Rh. Hopkinsi* from the list of British fossils.

ADDITIONAL SPECIES.

RHYNCHONELLA SUB-DECORATA (Dav.), Part III, Pl. XVIII, fig. 10, and Appendix, Pl. A, figs. 23—26.

„ TETRAHEDRA (part), Davidson, 'Mon. of British Oolitic and Liasic Brach.,' p. 95, Pl. XVIII, fig. 10, 1852.

Diagnosis. Shell obtusely deltoid; wider, but almost as deep as long; *dorsal* or socket valve much inflated and contracted at the umbo, whence it presents a longitudinal mesial curve, rising at almost right angles to the direction of the opposite valve, and attaining its greatest elevation near the front.

The surface is divided into three distinct lobes, forming a roof-shaped mesial fold, with wide flattened sides, gradually tapering as they approach the mesial crest, which is occupied by two, three, or four longitudinal ribs placed close to each other; the lateral lobes, declining rapidly to the margin, are ornamented by from five to six plaits. The *ventral* or *dental* valve presents a deep and wide longitudinal sinus, along the centre of which are situated one, two, or three small ribs, which correspond with those on the crest of the opposite valve. Beak short, greatly incurved, and hardly produced beyond the level of the umbone; foramen in general inconspicuous; beak-ridges well defined, leaving a wide flattened space between them and the hinge-line, which last indents to a considerable extent the corresponding margin of the dorsal valve. Dimensions variable: length, 11 lines; width, 10 lines; depth, 12 lines.

Obs. In 1850, Mr. Walton placed in my hands two examples of a *Rhynchonella* (Pl. XVIII, fig. 10), from the Inferior Oolite, near Cheltenham, and which seemed to possess some resemblance both to *Rh. decorata* (Schlotheim) and to *Rh. tetrahedra* (Sow.), and it was after much hesitation, that I then determined to consider the shells in question as a form or variety of *Rh. tetrahedra* (Sow.)

Early in 1854, I was informed by Mr. Lycett, that Mr. Jones, of Gloucester, had collected a number of similar examples from the Ragstones of the Inferior Oolite of Birdlip, Coopers, and Painswick Hills (Gloucestershire); that both in Mr. Jones's and his own opinion, the shell in question "was worthy to rank as a separate species," in corroboration of which the last-named gentleman forwarded for my examination a series of specimens of all ages, measuring from three to twelve lines in length, and which exhibited such marked and constant differences from *R. tetrahedra* proper, as to have urged upon me to propose for it the distinguishing denomination of *Rh. sub-decorata*.

When quite young, with an almost equal length and width, the mesial fold is hardly produced above the level of the lateral lobes (Pl. A, fig. 26); at the dimensions of about $5\frac{1}{2}$ lines in length, $4\frac{1}{2}$ in width, and $3\frac{1}{2}$ in depth, the shell exhibits a commencement of that mesial fold so largely developed and characteristic of the adult, (Pl. XVIII, fig. 10, and Pl. A, figs. 23, 24, 25). When full grown, the mesial crests generally presents three plaits, the central one being the most elevated, except in those cases where there existed two or four, the central ones then presenting an equal height, the lateral two on a lower level. With age the shell acquires additional width. I have proposed to designate this *Rhynchonella* by the specific denomination of *sub-decorata*, from its near approach to some varieties of *R. decorata* of Schlotheim, and although it appears to constitute a form intermediate in character between the last and *R. tetrahedra*, it possesses peculiarities which prevent its being united with either the one or the other.

In stratigraphical position, it is higher than that of any authentic *R. tetrahedra* hitherto discovered; and the present conclusion is founded upon the examination of twenty-four examples from the collections of Messrs. J. Jones, Walton, and Dr. Wright.

PART III.—Plate XVIII, fig. 10. A full grown example, with three plaits on the mesial crest, from the Inferior Oolite near Cheltenham, in the collection of Mr. Walton.

Plate A, fig. 23. A very adult individual, likewise with three plaits on the mesial crest, from the Inferior Oolite of Birdlip Hill.

fig. 24 and 26. Younger examples, with only two plaits; same locality.

fig. 25. A specimen, with four plaits (the four examples represented in Pl. A, are from the collection of Mr. J. Jones, of Gloucester).

RHYNCHONELLA QUADRIPLICATA, *Zeiten*, Sp. Plate A, fig. 22.

TEREBRATULA QUADRIPLICATA, *Zeiten*. *Dei Versteinerungen Württembergs*, pl. xli, fig. 3, 1832.

RHYNCHONELLA QADRIPLICATA, *D'Orbigny*. *Prodrome*, vol. i, p. 286, 1849.

Diagnosis. Shell somewhat pentagonal, trilobed, wider than long; *dorsal* or *socket* valve more convex than the ventral one, and almost equally divided into three lobes; the central one which forms the mesial fold is more or less produced beyond the lateral ones. In the *ventral* or dental valve a shallow sinus extends to the front; beak short, acute, and incurved, so as almost to entirely conceal the foramen, which lies contiguous to the hinge line and umbone of the opposite valve, the hinge line of the ventral valve indents laterally the same portions of the dorsal one. Externally, each valve is ornamented by about twenty large ribs, four of which occupy the mesial fold and sinus. Dimensions variable: length 16, width 17, depth 11 lines.

Obs. This species appears to be distinguished from *R. tetrahedra*, Sow., by its more equally trilobed, and less gibbous appearance. It has been found by Dr. Wright, in the Inferior Oolite of Cleeve Hill, near Cheltenham; and Mr. S. P. Woodward discovered (some years ago) a British specimen in the Inferior Oolite of Yeovil. *Zeiten* mentions, likewise, that his types were obtained from the upper beds of the Inferior Oolite, near Gosheim, and at Harras. M. d'Orbigny quotes his from the *Terrain Bajocien*, at Saint-Maixent, Draguignan, Namers, Geniveaux, and the neighbourhood of Nantua.

Plate A, fig. 22. A specimen, from the Inferior Oolite of Cleeve Hill, in the collection of Dr. Wright.

Note.—I may here state that the greater number of specimens figured in this volume, to which no named collection is appended, belong to my Cabinet.

CORRECTIONS TO THE PAGES FRONTING THE PLATES.

INTRODUCTION.

Plate IV, fig. 9.

For "calcified," *read* "decalcified."

Plate V, fig. 3.

For "(Triassic)," *read* "Jurassic."

Fig. 10. *For* "Thecidium pumila," *read* "Thecidium Mediterraneum."

Plate IX.

For "Spondylobus craniolaris," *read* "Spondylolobus craniolaris."

PART I.

Plate I.

For "Lingula Dumontieri," *read* "Lingula Dumortieri."

For "Orbicula lamellosa?" *read* "Discina lamellosa?"

Erase "fig. 8d," it having been *replaced* in the "Appendix, Pl. A, fig. 1."

PART II.

Plate III.

For "Argiope decemcostata," *read* "Argiope Bronnii."

PART III.

Plate III.

For "Orbicula Townshendi, O. Humphresiana," *read* "Discina Townshendi, D. Humphresiana."

Plate XIII.

For "T. Bentleyi (*Morris*), for the Cornbrash of Wollaston," *read* "from the Cornbrash of Rushden."

SUPPLEMENTARY ADDITIONS TO THE APPENDIX.

INTRODUCTION.

THE recent dissections of certain *Brachiopoda* published by Mr. Huxley, in the 'Proceedings of the Royal Society,' for June 1854,¹ have cast much light on certain points hitherto insufficiently explained; I will therefore, with the author's kind permission, make a few extracts from some of the most important questions there discussed.

Mr. Huxley's investigations have been principally made upon the animal of *Rhynchonella psittacea*, *Waldheimia flavescens*, and *Lingula anatina*, and chiefly relate to the *alimentary canal* and *circulatory systems* of those genera.

Mr. Huxley observes that Prof. Owen has stated that the intestine terminates on the right side between the lobes of the mantle; that, on the other hand, Mr. Hancock has declared himself unable to observe at this point any such anal aperture, and concludes from his own observations that the latter is situated on the ventral surface of the animal, in the middle line just behind the insertion of the great adductor muscle. (The termination of the alimentary canal in this position was observed by Mr. S. P. Woodward and myself, in *Terebratula vitrea*, *Terebratulina caput-serpentis*, *Waldheimia flavescens*, *Kraussia Lamarckiana*, and *Rhynchonella nigricans*; see 'Cat. Brach. in the British Museum,' p. 48, f. 5, 1853, &c.)² Mr. Gratiolet³ has also taken the same view, but as the spot thus mentioned is covered by the shell, and that there would be no road for the escape of the fæces if the anus existed there, Mr. Hancock and Mr. Woodward appeared inclined to suppose that some cloacal aperture must exist in the neighbourhood of the pedicle;⁴ Mr. Huxley continues to observe that his "repeated examinations of *R. psittacea* and *Waldheimia flavescens* is firstly, that the intestine does not terminate on the right side of the mantle as Professor Owen describes it (in *Terebratella*) but in the middle line, as Mr. Hancock represents it in *Waldheimia*,⁵ while in *Rhynchonella* it inclines after curving upwards to the left side; and secondly that there is *no anus at all*, the intestine terminating in a rounded cæcal extremity, which is straight and conical in *Waldheimia*, curved to the left side and enlarged in *Rhynchonella (psittacea)*. This strangely contrasting with the known relations of the anal aperture in *Lingula*.

¹ Published also in the 'Annals and Mag. of Nat. Hist.,' vol. xiv, 2d ser., p. 285, Oct. 1854.

² "The intestine is seen projecting above the oral aperture and fringe. The œsophagus passes through the annular part of the loop." 1853.

³ 'Comptes rendus de l'Académie des Sciences.' (Paris.)

⁴ 'Cat. Brachiopoda,' in the British Museum, p. 14, 1853. Mr. Hancock informs me "that he quite agrees with Mr. Huxley, regarding the cæcal nature of the intestine, inasmuch as he could not succeed in finding an anal outlet."

⁵ Introduction, p. 55, f. 1.

In *Rh. nigricans* the alimentary canal terminates exactly as in *Waldheimia*, and not as described by Mr. Huxley in *R. psittacea*. (See *Introduction*, p. 94, and 'Woodward's Manual,' p. 226.)

Mr. Huxley again states: "If the extremity of the intestine, either in *Rhynchonella* (*psittacea*), or *Waldheimia* (*flavescens*), be cut off and transferred to a glass plate, it may readily be examined microscopically with high powers, and it is then easily observable that its fibrous investment is a completely shut sac. In *Rhynchonella* (*psittacea*), the enlarged cæcum is often full of diatomaceous shells, which it is impossible to force out at its end, while if any aperture existed they would of course be readily extruded.¹

"However, anomalous, physiologically, then, this cæcal termination of the intestine in a molluscan genus may be, I see no way of escaping from the conclusion that in the *Terebratulidæ* (at any rate in these two species) it really obtains. There are other peculiarities about the arrangement of the alimentary canal, however, of which I can find either no account or a very imperfect notice.

"The intestinal canal has an inner, epithelial, and an outer fibrous coat; the latter expands in the middle line into a sort of mesentery, which extends from the anterior face of the intestine, between the adductors, to the anterior wall of the visceral chamber, and from the upper face of the intestine to the roof of the visceral chamber; while posteriorly it extends beyond the intestine as a more or less extensive free edge. I will call this the *mesentery*.

"From each side of the intestinal canal again the fibrous coat gives off two 'bands,' an upper which stretches from the parietes of the stomach to the upper part of the walls of the visceral chamber, forming a sort of little sheath for the base of the posterior division of the adductor muscle, which we will call the *gastro-parietal band*; and a lower, which passes from the middle of the intestine to the parietes, supporting the so-called '*auricle*.' I will call this the *ilio-parietal band*.

"The ilio-parietal and gastro-parietal bands are united by certain other ridges upon the fibrous coat of the intestine, from the point of union of which in the middle line of the stomach posteriorly, a pyriform vesicle depends. The mesentery divides the liver into two lateral lobes, while the gastro-parietal band gives rise to the appearance that these are again divided into two lobules, one above the other. I am inclined to think that these bands are what have been described as 'hepatic arteries,' at least there is nothing else that could be confounded with an arterial ramification of the liver. This description applies more especially to *Rhynchonella* (*psittacea*) and *Waldheimia* (*flavescens*), but the arrangement in *Lingula* is not essentially different."

Mr. Huxley enters into many important details connected with the *circulatory* system of *Terebratula flavescens*,² *Rhynchonella psittacea*, and *Lingula anatina*, and especially on the organs, "one on each side of the body which have been recognized as *hearts* since the time of Cuvier, who declared these hearts in *Lingula* to be aortic, receiving the blood from the mantle, and pouring it into the body; the principal arterial trunks being distributed into that glandular mass which Cuvier called ovary, but which is now known to be the genital gland of either sex.

"In 1845, however, M. Vogt's elaborate memoir on *Lingula*³ appeared, in which the true complex structure

¹ Mr. Woodward states that he forced the contents of the *canal* through its termination, with the forceps.

² It is only just to observe that Mr. Huxley has only examined *Waldheimia flavescens*, which he places in opposition with those of *Terebratella chilensis*, on which Professor Owen's views were founded, but which he has not examined, so that at present the examinations not being made on the same animals cannot finally invalidate the statements of Professor Owen.

³ Neue Denkschriften der Schweizerischen Gesellschaft für die gesammte Wissenschaften; or, 'Nouveau Mémoires de la Soc. Helvétique,' vol. vii, p. 1, 1845. I may also state, that Cuvier's first paper on the *animal of Lingula*, was published in the 'Bulletin de la Soc. Philomatique of Paris,' vol. i, p. iii, Pl. 7, 1797. He there states: "Il paraît que ce genre (*Lingula*) dans lequel on connaît déjà trois espèces, réuni avec les *Terebratulæ*, la *Fissurelle* de Bruguière et le *Patella anomala* de Linneus peut former une famille assez naturelle dans l'ordre des Acéphales."

of the 'heart' in this genus was explained, and the plaited auricle discriminated from the ventricle in *Waldheimia flavescens*." Mr. Huxley observes two of these "hearts" situated as described by Professor Owen, but in *Rhynchonella psittacea* he found four: the auricles of this last being smaller, both actually and proportionally than in *Waldheimia*. "Two of these occupy the same position as in *Waldheimia* close to the origins of the calcareous crus: while the other two are placed above these and above the mouth, one on each side of the liver."

After entering into minute details regarding the mesenteric and other bands which support the alimentary canal¹ and "hearts," Mr. Huxley concludes that "the facts then with regard to the real or supposed circulatory organs of the *Terebratulidæ* are simply these:

"1. There are two or four (*hearts*), composed each of a free funnel-shaped portion with plaited walls, opening widely into the visceral cavity at one end, and at the other connected by a constricted neck, with narrower, oval or bent, flattened cavities, engaged in the substance of the parietes. The existence of muscular fibres in either of these is very doubtful, it is certain that no arteries are derived from the apex of the so-called ventricle; but, whether this naturally opens externally or not is a point yet to be decided.²

"2. There is a system of ramified peripheral vessels.³

"3. There are one or more pyriform vesicles.

"4. There are the large sinuses of the mantle, and the visceral cavity into which they open."

To determine in what way these parts are connected, and what functions should be ascribed to each: it appears to Mr. Huxley, and indeed to us all, that much further research is required; and it is to be hoped that some one provided with an ample supply of specimens may take up the subject, for it is only by such aid, that the difficult problems involved in this investigation can be settled.

Mr. Huxley concludes his valuable memoir by stating, "All we have seen of the structure of these animals leads me to appreciate more and more highly the value of Mr. Hancock's suggestion, that the affinity of the *Brachiopoda* are with the *Polyzoa*. As in the *Polyzoa* the flexure of the intestine is neural,⁴ and they take a very natural position among the neural mollusks, between the *Polyzoa* on the one hand, and the LAMELLIBRANCHS and PTEROPODA on the other.

"The arms of the *Brachiopoda* may be compared with those of the *Lophophore Polyzoa*, and if it turns out that the so-called hearts are not such organs, one difference will be removed. In conclusion, I may repeat what I have elsewhere adverted to, that though the difference between the cell of a *Polyzoon* and the shell of a *Terebratula* appear wide enough, yet the Avicularium of a *Polyzoon* is exceedingly close and striking."⁵

¹ The Mesenteric band is particularly interesting in relation to the *dorsal septum* of *Pentamerus* and the "Shoe lifter," process of *Camarophoria*.

² Mr. Hancock and Mr. Huxley deny the arterial origin of the centre lines observed in the vascular impressions of *Camarophoria* by (King), and *Terebratella* by (Owen.)

³ It is a portion of this system which appears to have been described as a *muscular* structure for injecting and extending the arms.

I may also here remark that Mr. Hancock appears to believe that the so-called Cuvierian hearts will prove not to be "hearts." He also informs me that the peripheral net-work or sinuses undoubtedly exist, and that he has frequently seen them both in the mantle, arms, and elsewhere.

⁴ The term "neural" is applied by Mr. Huxley to the *ventral* side of invertebrate animals; in the vertebrata the *dorsal* side is "neural."

⁵ Mr. Huxley's examination of the ovarian sinuses of *Rhynchonella psittacea* is quite confirmatory of the interpretation given by Mr. Woodward and myself of the remarkable spaces in the ORTHIDÆ and RHYNCHONELLIDÆ, and of the distinction (founded on them) between these families and the TEREBRATULIDÆ.

Family—TEREBRATULIDÆ.

Sub-Genus? *ZELLANIA*, Moore, 1854.¹Type. *Zellania Davidsoni*, Moore.

Diagnosis.—Shell minute, with a small area in each valve; foramen large, and more or less circular, encroaching on both valves; hinge articulating by the means of teeth and sockets; valves convex, dorsal one usually most so; external surface rugose, showing a slight tendency to striation, or marked by concentric lines of growth, which appear more defined on the ventral than on the dorsal valve; ventral valve having sometimes a slightly produced beak. Interior of *dorsal valve* showing a flattened granulated margin, surrounded by an elevated ridge, which, commencing immediately under the dental sockets, passes to front of the valve, and is there united by a central septum.

Obs. These shells approach in their exterior form to *MORRISIA*, having the large and rounded foramen encroaching on both valves as in that sub-genus. Their internal character, however, shows that they have affinities with *Argiope* and *Thecidium*, and will consequently link more closely the *Terebratulidæ* to the *Thecideidæ*.² This genus is not uncommon, being represented in the Upper Lias by one, and in the Inferior Oolite by two species.

Family.—SPIRIFERIDÆ.

Sub-Genus? *SUESSIA*, E. Deslongchamps, 1854.³Type—*Suessia Costata*, E. Deslongchamps.

Among the many new forms of *Brachiopoda* lately discovered by Mr. E. Deslongchamps in the Upper Liasic beds of May, near Caen (France), were two species of *Spiriferida*, which appeared to him to possess characters sufficiently distinct from the other sections in the family, to admit the propriety of creating for their reception a separate section or group, to which he has applied the name *SUESSIA*. I am unprepared to offer a positive opinion as to the value of this section, not having yet been able to study examples sufficiently perfect. All we at present know of its characters have been described and illustrated by the distinguished French author.

In general external contour and aspect, the two species of *Suessia* at present known (*S. costata* and *S. imbricata*) differ but little from certain forms of *SPRIFERINA*, such as *Sp. Münsteri*, &c.; but while in this last the shell structure is perforated, it is said to be impunctate in *SUESSIA*.

The interior of the *dorsal valve* is still imperfectly known. Between the sockets may be seen a small trilobed cardinal process (to which were fixed the cardinal muscles); the hinge plate is largely developed, extending to about a little more than a third of the length and breadth of the valve, deeply notched in front. It is formed of two concave plates, united longitudinally under the cardinal process. On these plates are seen the four grooved depressions for the insertion of the pedicle muscles, the lateral ones being by far the largest. At the base of the sockets the hinge-plate presents a peculiar (hook-shaped) incurved process; from the base of each plate the lamellæ forming the first coil of the spire proceed, and are directed towards the front; but before becoming spirally reflected, each lamella is united towards the centre of the valve by a transversal lamellar process, in the shape of a T (the spire is still unknown). The quadruple impressions of the adductor seem to be placed as in other *Spirifers*, and separated by a slight longitudinal ridge.

¹ This description was obligingly communicated by Mr. Moore, and will be found published, with figures, in the 5th volume of the Somerset Archæological and Natural History Society for 1854.

² Refer to Mr. E. Deslongchamps' able memoir, now publishing in the 10th volume of the 'Transactions of the Linnean Society of Normandy,' 1855.

³ 'Annuaire de l'Institut des Provinces,' for 1854. Named after the distinguished Viennese author, M. Suess.

In the interior of the *ventral valve* the dental plates are largely developed, the space between the cardinal muscular impressions being occupied by an elevated mesial septum, to the upper edge of which are fixed two small horizontal triangular plates (in the shape of a shovel). Mr. E. Deslongchamps infers that the place this little group should occupy is one intermediate between *Spirifer*, Sow., and *Spiriferina*, D'Orb.

NOTE.—*The reader is referred to my Memoir on the 'History of the Brachiopoda,' to be published in the 'Transactions of the Linnean Society of Normandy' (France), vol. x, 1855; also to the same subject printed in the 'Transactions of the Zoological Society of Vienna' (Austria) for 1855. Therein all the improvements suggested to my INTRODUCTION will be found fully explained.*

PART III.

The following new species were discovered by Mr. Moore after my plates had been printed, so that all I can do at present is to add the descriptions communicated by Mr. Moore, and refer for further details, as well as figures, to the fifth volume of the Somerset Archæological and Natural History Society for 1854.

Sub-Genus—ZELLANIA, Moore.

1. *ZELLANIA DAVIDSONI, Moore.*

Shell small, rugose, widest at the front, contracting slightly towards the beak, occasionally presenting a tendency to striation; large and rounded foramen; beak slightly produced; valves convex, the dorsal one but slightly so. Interior presents a rugose structure similar to the exterior of the shell; dorsal valve has a flattened granulated margin, surrounded by well-defined internal ridges, commencing immediately under the dental sockets.

Obs. The interior of the dorsal valve and the arrangement of the ridges is not unlike *Thecidium rusticum*. It is from the Inferior Oolite of Dundry, where it is not uncommon.

2. *ZELLANIA LABOUCHEREII, Moore.*

Shell minute, thin, of an elongated oval shape; front rounded; both valves equally convex; foramen rounded and large, encroaching on both valves; ventral valve having distinct concentric lines of growth, which in the dorsal valve are not perceptible.

Obs. The internal organization of this species is unknown. It is readily distinguishable from *Z. Davidsoni* from its more oval shape and less rugose exterior, and by the lines of growth, which are well defined and constant.

Locality. Inferior Oolite, Dundry; rare.

3. *ZELLANIA LIASIANA, Moore.*

Exterior of shell smooth, square; valves thin and flattened; ventral one slightly concave, dorsal slightly convex; foramen large, triangular. Three internal ridges usually showing through the shell give its exterior a plicated appearance. Interior of the *dorsal valve* shows three strongly defined ridges; the outer, commencing under the dental sockets, slightly curve to the sides of the valve, and are usually lost towards the front of the shell; the central, commencing at the frontal margin of the shell, generally divides it through its whole length.

Obs. This species is from the Upper Lias of Ilminster, where it is rare. It differs from the other species by its flattened contour, and by the less symmetrical arrangement of the internal ridges.

4. *THECIDIUM DUPLICATUM*, Moore.

Shell long as deep; both valves convex, nearly equivalve; hinge line straight; deltidium small and ill defined. Interior of dorsal valve shows a regularly granulated margin, from the centre of which, on an enlarged base, rises a frontal ridge or septum, from whence is thrown off on either side a sharp ridge, covered in its whole course with irregularly shaped calcareous processes, which appear long enough to pass to the interior surface of the ventral valve. The lateral ridges returning to the central one describe two circles. The *dental valve* shows three short lamellar processes under the deltidium.

Obs. This shell is associated with *Th. Bouchardii*, which passes from the *Upper Lias* into the *Inferior Oolite*, and with *Th. triangularis*. Externally it is not unlike *Th. Deslongchampsii*, but its internal characters, which are very constant, remove it from that species.

Locality. Inferior Oolite, Dundry.

5. *THECIDIUM SERRATUM*, Moore.

Shell small, inequivalve, triangular, wider than deep; deltidium triangular, elevated, and well defined; dorsal valve small, exterior smooth: attached by a large portion of the ventral valve, which shows regular striæ. Internal margin of dorsal valve deeply furrowed, occupying half the area of the valve; from the margin proceed two small curved ridges, which terminate under the dental sockets.

Obs. In most species of *Thecidium* the margin presents a granulated structure. This species is the only one known presenting such a serrated margin, and may be at once distinguished by this character. It is from the Inferior Oolite of Dundry.

6. *THECIDIUM SEPTATUM*, Moore.

Shell thick, transversely oval; entire margin of the dorsal valve marked with fine and regular granulations. Interior of the dorsal valve shows a septum or ridge, from which, in the centre, proceed lateral branches assuming the form of the letter Y, traversing the length of the shell, and occasionally dividing it into three equal parts.

Obs. The dorsal valve only of this species is known. It is more persistent in form than is usual with most species of *Thecidium*. Inferior Oolite, Dundry; rare.

7. *SPIRIFER OOLITICA*, Moore.

Shell very minute, area large, triangular: beak produced; usually much broader than long; having nine distinct plications graduating regularly from the central one which is in relative proportion to the others; without defined sinus or fold; punctuations not distinguishable: interior of the valves smooth: dorsal valve having large and deep dental sockets: ventral valve having no perceptible central septum.

Obs. The discovery of this little spirifer is of interest as it for the first time extends the range of this genus into the Oolitic period. It is associated with the Brachiopods above described.

Locality. Inferior Oolite, Dundry.

8. *RHYNCHONELLA TRIANGULARIS*, Moore.

Shell small, thin, triangular, depressed, nearly smooth: deltidium triangular: beak produced, but slightly incurved; ventral valve slightly convex, dorsal valve proportionally concave; thickest at the umbo, nearly straight in front, from which it tapers regularly to the beak.

Locality. Inferior Oolite, Lopen near Ilminster; rare.

APPENDIX.

PLATE A.

RECENT AND TERTIARY.

Fig.

1. Waldheimia (Ter.) cranium. Interior of the dorsal or socket valve; to replace
• PART I, Pl. I, fig. 8^d.
2. Terebratula bisinuata, *Lamarck*. Barton Cliff, Hampshire.
- 3 to 5. Lingula tenuis, *Sow*. Figs. 3, 4, nat. size; 5, enlarged, from an unpublished
figure of Mr. Wetherell's. London Clay, Highgate.

OOLITIC AND LIASIC SPECIES.

6. Thecidium Deslongchampsii, *Dav*. Leptæna Bed, Ilminster.
6^{a b c} „ „ Enlarged.
- 7, 8. Terebratula Etheridgii, *Dav*. Inferior Oolite? Dundry.
9. „ equestris, *D'Orb.*? Grip. Wood?
- 10 to 13. „ ? perhaps, a var. of *T. sphæroidalis*, *Sow.*, Dundry.
14. „ Phillipsii, *Morris*. Cleeve hill, in the collection of Dr. Wright.
15. „ galeiformis, *M'Coy*, M.S. = *T. sub-Bentleyi*, *Dav*. Inferior Oolite,
near Minchinhampton, in the Cambridge Museum.
16. „ sphæroidalis, *Sow.*, var. Chideoch Hill, in the collection of Dr.
Wright.
17. „ carinata, *Lamarck*, var. Inferior Oolite, Ravensgate hill, near
Cheltenham, in the collection of Dr.
Wright.
18. „ globata, *Sow*. A very elongated variety, from Inferior Oolite,
Minchinhampton, in the collection of Mr. Lycett.
19. „ sub-maxillata, *Morris*. Young; much resembles the *T. pentu-*
hedra, Münster.
- 20, 21. Rhynchonella Hopkinsi, *M'Coy*. The original specimen, in the Cambridge
Museum, in all probability *not British*.
22. „ quadruplicata, *Zeiten*. Inf. Oolite, Cleeve Hill, near Cheltenham.
- 23 to 26. „ sub-decorata, *Dav*. Inferior Oolite, Birdlip Hill, Gloucestershire;
a series of ages, and varieties.
27. „ Wrightii, *Dav*. A variety with four plaits on the mesial fold.
- 28; „ ? labelled. Dundry, in the British Museum.

INTRODUCTION.

29. Chonetes comoides, *Sow*. sp. Interior of the ventral or dental valve. A, adduc-
tor; c, cardinal muscular impressions. (See
Appendix, p. 6.)

APPENDIX

RECENT AND TERTIARY



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ERRATUM.

Appendix, p. 15, line 5 from bottom, for *Sp. liasiana*, read *Sp. oolitica*.

FINIS.

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MONOGRAPH

ON

THE FOSSIL REPTILIA

OF THE

WEALDEN FORMATIONS.

PART II.

DINOSAURIA.

BY

PROFESSOR OWEN, F.R.S., F.L.S., F.G.S., &c.

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MONOGRAPH
ON THE
FOSSIL REPTILIA
OF
THE WEALDEN FORMATIONS.

ORDER—*DINOSAURIA*.*

(Cervical and anterior dorsal vertebræ with parapophyses and diapophyses; dorsal vertebræ with a neural platform; sacral vertebræ exceeding two in number; body supported on four well-developed unguiculate limbs.)

Genus—IGUANODON.

Dentes incrassati, marginibus lammellosis.

In a former Monograph 'On the Fossil Reptilia of the Cretaceous Formations,' 4to, 1851, p. 105, the vertebral characters of the dorsal and caudal regions of the spine of the Iguanodon were described and figured, as they were exhibited in the instructive specimen obtained by Mr. W. H. Bensted, from a Green Sand formation near Maidstone; in the present Monograph it is proposed to illustrate the characters of the rest of the skeleton, so far as undoubted parts of it have been obtained from the Wealden Strata, in which the first evidences of the Iguanodon were discovered by Dr. Mantell, and from which the most abundant and varied remains of this remarkable herbivorous reptile have since been obtained.

* Report on British Fossil Reptiles, 1841, in 'Trans. Brit. Association,' 8vo, 1842, p. 102. Pictet, 'Traité Élémentaire de Palæontologie,' 8vo, tom. ii, 1845, p. 52. From the Greek *δεινός*, fearfully great; *σαῦρος*, a lizard.

*Description of part of the Skeleton of a Young Iguanodon. Tab. I.*IGUANODON MANTELLI, *Mantell*.

A considerable and very instructive part of the skeleton of a young Iguanodon, the entire body of which was probably under two yards in length, was discovered in the Wealden formations, about one hundred yards west of Cowleaze Chine, on the south-west coast of the Isle of Wight, in the year 1849.

The mass of Wealden stone in which this skeleton was imbedded, was broken into two parts in its extraction from the bed; and, as happened with the skeleton of the *Dolichosaurus*, described in a former Monograph,* the workmen disposed of one part to one collector, and of the other to another. Mr. Bowerbank was so fortunate as to become the possessor of that portion which contained the most important part of the skeleton, and which forms the upper division of the chief figure in the plate, Tab. I, where it is represented of the natural size.

This portion includes seventeen vertebræ, extending from the neck to near the pelvis inclusive: the pelvis apparently forms a continuation of the vertebral series, but is obscured by the principal bones of the right hind foot, *mt*, *pl*, 1 and 2. Some portions of ribs, *pl*, *pl*, and of a coracoid, 52, in the proximal part of the left femur, 65, the distal halves of the right tibia, 66, and fibula, 67, and a fragment of the left tibia, 66, are also imbedded in the same block of stone. The other portion of the block fell into the possession of Dr. Mantell, and is now in the British Museum. It includes eleven consecutive caudal vertebræ, with some of their hæmapophyses, *h*, *h*; the right femur, 65, the proximal halves of the right tibia, 66, and fibula, 67, and parts of the left tibia, 66', and fibula, 67'. The bones of the right hind leg are almost completed when the blocks containing their opposite ends are brought into juxtaposition, as in Tab. I.

Of the seventeen vertebræ, in Mr. Bowerbank's specimen, the three anterior, 1, 2, 3, have been detached and carefully worked out: they appear to have immediately preceded the rest which remain imbedded in the block, and which are unequivocally consecutive; including the detached three, the seventeen vertebræ occupy an extent of thirteen inches.

The first three vertebræ, as imbedded and naturally cemented together, exhibit a slight upward curvature, and the five following vertebræ are bent in the same direction, but in a less degree: the rest present a moderate bend with the concavity downwards or towards the abdomen. The whole of this series, therefore, describes a gentle sigmoid curvature, like that which may be observed in the naturally articulated

* 'Fossil Reptilia of the Cretaceous Formations,' 1851, 4to, p. 22. Cuvier had to contend with similar difficulties; see 'Ossem. Foss.,' t. v, pt. ii, p. 148.

vertebral column of a young Alligator from the fourth cervical to the first lumbar vertebræ inclusive; which vertebræ are also seventeen in number in that reptile. Supposing the vertebræ of the young Iguanodon in question to be the homologous or nearly homologous vertebræ to those of the Alligator compared, the characters of the cervical vertebræ are given by the detached specimens, 1, 2, and 3, fig. 1, and figs. 2, 3 and 4, forming the anterior end of the series, and the degree of curvature shown by these vertebræ, which have been fixed together by the matrix, as they were naturally juxtaposed at the animal's death, and the slenderness of the portions of the ribs, *pl*, fig. 2, therewith preserved, add to the probability that they belonged to the neck.

In my 'Report on British Fossil Reptiles,' 1841, tom. cit., p. 126, I showed that the cervical vertebræ, which had been referred by Dr. Mantell to the Iguanodon, on the supposition that such vertebræ had ball and socket articular extremities, placed as in the neck-vertebræ of the Iguana, had, in fact, these articular surfaces situated in a reverse position to those in the Iguana and most existing Saurians, and that they agreed in that peculiarity with the vertebral characters which Cuvier had demonstrated* in an extinct Saurian genus, subsequently called *Streptospondylus*. I had previously, however,† suggested the possibility that such Streptospondylian vertebræ from the Wealden might be the cervical ones of a large Saurian having plain-surfaced or concave vertebræ in the dorsal and lumbar regions. The authors of the paper 'On the Osteology of the Iguanodon,' in the 'Philosophical Transactions' for 1849, adopting this idea,‡ have applied it to the Iguanodon itself, but on no better grounds than a conjectural guess, which considerations of difference in other characters and proportions forbid my hazarding, when maturely considering the nature of the anteriorly convex vertebræ from the Wealden, in my 'Report.' Accordingly, in regard to the cervical vertebræ of the Iguanodon, I restricted myself to the following remark: "The desirable knowledge, therefore, of the anatomy of that region of the spine in the Iguanodon, which in other Saurians is usually distinguished by its well-marked and varied characters, remains to be acquired." p. 126.

* 'Ossem. Foss.,' v, pt. ii, p. 153, pl. 8 and 9.

† 'Report,' Op. cit., p. 96.

‡ P. 273. The reference to my observation is so made as to compel me to reproduce textually the passage in which the possible nature of Streptospondylian vertebræ was first indicated. "Since the vertebræ of the *Streptospondylus* lose their peculiar convexo-concave character by the gradual subsidence of the anterior ball, as they approach the tail, the cervical vertebræ of the *Cetiosaurus* may approach, more nearly than do the dorsal ones, to the convexo-concave structure of the Streptospondylian vertebræ. The fact that, hitherto, only cervical vertebræ of the great *Streptospondylus*, and only dorsal and caudal vertebræ of the *Cetiosaurus*, have been discovered in the Wealden formations, has induced me well to consider the grounds for assigning them to Saurians of distinct genera. But the general constancy of the vertebræ of the same Saurian in their antero-posterior diameter, forbids the supposition of a vertebra of six inches in length in the neck being associated with one of three inches in length in the back. Additional evidence of a very decisive character must at least be obtained before the great Cetiosaur can be admitted to have resembled the Pterodactyle in such disproportionate length of the cervical vertebræ." p. 96.

The following are the characters of the cervical vertebræ in Mr. Bowerbank's young *Iguanodon* :

The centrum partakes of the characteristic of that part in the dorsal region, in its lateral compression and the convergence of its sides to a very narrow inferior surface : but this wedge-shaped characteristic is exaggerated in the present vertebræ ; the sides are naturally more compressed between the fore and hind articular ends ; they are concave, not only lengthwise but vertically, and they meet below at a ridge from which a process—the hypapophysis—appears to have descended ; for, though the ridge itself, *hy*, figs. 2 and 4, extends below the level of the articular ends of the centrum, it shows a fractured edge ; and the hypapophysis is the characteristic of the cervical region in most saurian reptiles. As the neural canal retains its original capacity—the arch showing no marks of pressure,—the compression of the middle part of the sides of the centrum cannot be regarded as the effect of crushing ; it is the same on both sides, and the expanded articular ends seem to exhibit their natural and symmetrical form,* as in fig. 4, Tab. I. This form differs from that in the dorsal region,† by being narrower in proportion to its depth, and repeats in this proportion the character of the same part in the caudal region;‡ but the contour of the cervical centrum is different from that of the caudal one : the anterior surface resembles an ancient shield, the sides slightly diverging as they descend to the parapophyses, and then more rapidly converging to the inferior ridge ; the contour of the hinder surface, fig. 4, is an oval, a little flattened above at the larger end. The deep pit at the side of the centrum characteristic of the cervical and anterior dorsal vertebræ of the *Streptospondyl* is not present in the corresponding vertebræ of the *Iguanodon*. In these vertebræ the anterior articular surface is nearly flat vertically, very slightly concave at the middle, and as feebly convex above and below. Transversely the surface is slightly convex, and most so where it is continued, just above the middle of the surface, upon the parapophyses. The hinder surface is gently and pretty uniformly concave.

Both surfaces are devoid of that smooth or polished character which is observable in the Reptiles that have those surfaces coated by articular cartilage, and have their vertebral centrams articulated by synovial capsules ; concentric striæ are plainly manifest near the border of the articular surface, whence I conclude that the vertebral bodies of the *Iguanodon* were *coarticulated by means of an intervertebral ligamentous substance, as in the class Mammalia*. That such substance intervened between these

* The assertion in the paper above cited, 'Phil. Trans.,' 1849, p. 303, that the three vertebræ here described "have been crushed and compressed almost flat laterally" has reference to an idea that they were homologous with the *Streptospondyl*ian vertebra described in my 'Report,' p. 92, the different form and proportions of which are explained by the authors of that paper on the assumption that that vertebra "has been compressed in an opposite direction," *ib.* p. 303.

† 'Mon. Cretaceous Reptiles,' tab. xxxvi.

‡ *Ib.*, tab. xxvii.

most freely moveable cervical vertebræ, and, *à fortiori*, therefore, between the less moveable dorsal, lumbar, and caudal vertebræ, is further indicated by the interval separating the centruns in the three cervical vertebræ preserved with the natural co-adaptation of their zygapophyses, and with their natural upward curvature, in the specimen figured in Tab. I. The elasticity of the concentric ligamentous substance has permitted the vertebral bodies, in this upward flexure, to be more divaricated at their lower than at their upper borders.

Nothing in the characters of these unequivocal vertebræ of the Iguanodon affords any countenance to the conjecture that the broad and sub-depressed convexo-concave, or streptospondylian vertebræ, which I had stated might be a cervical modification of the vertebral column of the Cetiosaur, are from the cervical region of the Iguanodon. The parapophysis of the true cervical vertebræ of this reptile, figs. 2 and 4, *p*, is developed, in a great proportion from the centrum, in a less proportion from the neurapophysis, close to the anterior articular end of the centrum, which surface is continued upon the parapophysis. This process is short, obtuse, and terminates by a surface for the attachment of the head of the rib.

The neurapophyses, which are confluent at their summit, remain free below, where they are joined by suture to the centrum, embracing the upper third of the articular end. They contribute, as above stated, a small proportion to the parapophysis; ascend a short way vertically with a smooth and concave outer surface, then develop large zygapophyses, and, from the outside of the anterior of these, *z*, send out a diapophysis, *d*, for articulation with the tubercle of the rib. The neural arch is notched before, and more deeply behind; there is a ridge above each zygapophysis, and these ridges converge to the base of the neural spine. The broad, flat articular surface of the anterior zygapophysis, *z*, looks inwards and a little upwards and backwards; that of the posterior zygapophysis, *z'*, exhibits, of course, the opposite aspects; the outer border of both zygapophyses is rounded. The zygapophyses are not connected, externally, by a ridge continued forwards and backwards from the diapophysis, as in the dorsal vertebræ, where such ridges form the neural platform, Tab. XXXV, *n, n'*. The neural canal is proportionally wider than in the dorsal vertebra of the older Iguanodon ('Monogr. Cretaceous Reptiles,' Tab. XXXVI), but this is no doubt due to both the comparative immaturity of the present specimen, and to the more advanced region of the spine, formed by the vertebræ under consideration.

The bases of the neurapophyses do not extend so far inwards as in the dorsal vertebræ, but leave a median tract of the floor of the neural canal which is formed by the centrum itself: this part of the centrum sinks into a hollow, and is perforated by the myelonal veins.

The antero-posterior extent of the base of the neural spine is two lines, that of the neurapophysis, between the extremes of the anterior and posterior zygapophyses, being thirteen lines: the spine is much compressed laterally: it has been broken off near its

origin in all the three detached vertebræ: there is a deep angular depression behind its base, between the two converging ridges from the posterior zygapophyses, probably for the implantation of an elastic ligament.

The proximal end of a slender pleurapophysis, *pl.* fig. 2, adheres by the matrix to the left side of the second and third of the three vertebræ above described; the neck of the rib is moderately long and rounded, truncate, and not expanded at its articular end; the tubercle is produced, and beyond that the rib becomes compressed: unfortunately only a small part of the body of the rib is preserved.

Of the succeeding vertebræ, imbedded in the matrix, the flat or slightly concave character is resumed in the anterior surface of the centrum of the third, counting backwards.

The modification of the articular terminal surfaces, slight as it is in the cervical vertebræ above described, may be readily understood to relate to the corresponding increase in the extent and facility of motion of that part of the spine. But such modification gives no support to the idea that the vertebra, No. $\frac{116}{2118}$ in the British Museum, provisionally referred to the *Streptospondylus major* in my 'Report on British Fossil Reptiles,' p. 92, but with the intimation of its being possibly a cervical vertebra of the *Cetiosaurus brevis* (*ib.*, p. 96),—and referred by Dr. Mantell to the *Iguanodon Mantelli* in the 'Geology of the South East of England,' 8vo, 1833, p. 300, and by Dr. Melville to the same reptile, in the 'Phil. Trans.,' 1849, p. 301, Pl. XXVIII, fig. 4,—really appertained to the cervical region of the Iguanodon.

We have not, as yet, any evidence of so marked and sudden a change in the forms and proportions of a cervical vertebra, between the dentata and the fourth or fifth, occurring in any reptile or mammal, as would be the case were the vertebræ, described in p. 92 of my 'Report,' to belong to the Iguanodon; and the absence of such evidence prevents me now, as at the period when those vertebræ were first described, from hazarding or acceding to the hypothesis.

In the vertebræ succeeding those, 1, 2, 3, here regarded as cervical in the young Iguanodon, Tab. I, the sides of the centrum continue to be compressed, with a surface flat vertically, and concave longitudinally, and meeting below at a ridge, as far as the twelfth, counting backwards, and including the three detached cervicals: at the fourteenth vertebra the lower part of the centrum is broader, and is convex transversely. The parapophysis has ascended upon the neurapophysis in the fifth vertebræ, counting backwards; and in the sixth the contour of the articular terminal surface is oval, with the small end downwards: it is shown to be elliptical in the sixteenth vertebra.

The neurapophysial sutures are retained throughout the series of the seventeen successive vertebræ. In the seventh, sufficient of the neural arch is preserved to show the interzygapophysial ridge, forming the base of the expanded bony platform, *n*; a part of the neural spine, *n* 5, of this vertebra is preserved, to an extent equaling the vertical diameter of the rest of the vertebræ: it is compressed, but of considerable

antero-posterior extent. The zygapophyses, *z*, *z'*, diminish in size, and their articular surfaces become more vertical as the vertebræ approach the pelvis. The left pleurapophyses, *pl*, *pl'*, of the first five of the imbedded vertebræ, or those succeeding the three cervicals, seem to show a progressive and rapid augmentation of length, indicative of their formation of the fore part of the thorax, but the extremities of all their ribs appear to have been broken off: the inner surface, which is exposed, shows a longitudinal groove; traces of ribs continue to the seventeenth vertebra. There are impressions of spines of three vertebræ, beyond this, before we come upon the blended mass of the pelvis and hind foot. Before describing the pelvis, some notice is required of the peculiarities of those elements of the cervical and dorsal vertebræ which, from their development and retention of their primitive separation, are usually regarded as distinct bones, called "ribs."

RIBS OF THE IGUANODON. Tab. II.

These appendages, or elements, of the vertebral column are present throughout a great proportion of its extent, but become anchylosed, and reduced to the character and function of transverse processes in the lumbar, sacral, and caudal regions. They are free and largely developed in the thoracic-abdominal region of the spine, at the fore-part of which they have the same two-fold connexion with the vertebræ as in the Crocodilians. In the cervical region the rib is articulated by a "head," supported on a long neck, to a short sessile inferior transverse process or "parapophysis," and by a large "tubercle" to a superior transverse process or "diapophysis;" a portion of a cervical rib is slightly disarticulated and turned forwards in one of the hinder cervical vertebræ of the young Iguanodon, figured in Tab. I, fig. 2, so as to show most clearly the nature of this two-fold articulation; as the ribs increase in length, at the fore-part of the thorax, each is joined by a large head to a shallow cavity, situated at first on the side of the centrum and then on the side of the neurapophysis, as at Tab. XXXV, *p*, 'Mon. Cretaceous Reptiles'; and it was also articulated, as in the neck, by a tubercle, to the extremity of the diapophysis. In a certain number of the anterior thoracic vertebræ, the neck of the rib is co-extensive with the diapophysis, and is sometimes six or seven inches in length; afterwards the neck of the rib begins to shorten, and the head to decrease in size, and to have its place of articulation brought progressively nearer to the tubercle and to the end of the diapophysis, until it finally disappeared, and the posterior ribs became appended to the ends of the diapophyses.

In the Iguana, as in other Lizards, the ribs have but one mode of articulation, viz., to a simple tubercle developed from the side of the centrum.

One of the largest double-jointed ribs of the Iguanodon, in the Mantellian Collection (No. ⁵¹⁹/₂₅₁₉), is 46 inches in length, its proximal or vertebral end is represented

in Tab. II, figs. 1 and 2. The neck is less distinct from the tubercle and body than in other ribs which seem to have been situated further back; it expands more gradually to the tubercular articulation with the diapophysis, and is at this part 5 inches in breadth; it bends with a deep oblique curve for about one fifth of its length, and then is continued in a nearly straight line to its extremity: this is slightly expanded and truncated, for the attachment doubtless of a bony sternal rib. The convex or outer margin of the rib is bent backwards so as to overhang the sub-compressed shaft of the bone along its upper or proximal third part.

The proximal extremity of one of the ribs from the middle of the trunk of the Horsham Iguanodon, presents an ovate head $2\frac{1}{2}$ inches in the long diameter; the neck is 7 inches long, straight, compressed, and topped by a well-marked tubercle, where it joins the body of the rib. This part is also compressed; and its external margin, besides being bent backwards, is also developed in the contrary direction, so as to assume the form of a slightly convex plate of bone 2 inches broad, attached at right angles to the shaft of the rib, which it overhangs on both sides. This structure is characteristic also of some of the ribs in the other Dinosaurs, and is interesting as indicating the commencement of that peculiar development of the corresponding part of the ribs in the Chelonian reptiles, by which, and their connexion with continuous dermal ossifications, the lid of their bony box is almost wholly formed.

In fig. 3, Tab. II, is given a view of the upper surface of the head, neck, and tubercle, and expanded beginning of the shaft of a rib of an enormous Iguanodon, the part so represented measuring 10 inches in a straight line. A ridge is developed from the upper surface which, at the tubercle, expands into the overhanging plate of bone. In a more posterior rib, figs. 4 and 5, the tubercle is more distinctly developed, and continues so to be as the neck progressively shortens, as in figs. 6—10, Tab. II. Fig. 8 gives a view of an almost entire pleurapophysis, or “vertebral” rib, from about the middle of the thoracic abdominal cavity, the length of which, in a straight line, from the tubercle to the fractured end of the body, is 32 inches. The common form of the body of the rib is that exemplified in the transverse section of the rib, given at fig. 1. The number of thoracic abdominal vertebræ, supporting such free and more or less elongated ribs, was probably about fifteen.

SACRUM OF THE IGUANODON. Tab. III, IV, V and VI. (Half nat. size.)

The facts ascertained relative to the structure of that part of the vertebral column, answering to the “true vertebræ” in Human Anatomy, of the Iguanodon, had tended, at the period of preparing my ‘Report on British Fossil Reptiles,’ in 1840, to rectify the ideas on the Lacertian affinities of that reptile, suggested by its name, and had proved the Iguanodon to belong to a more highly organized section of the then-defined Saurian

order than the Iguana and the rest of the Lizard-tribe. The two costal articulations, viz., for the head and tubercle of the rib on the anterior dorsal vertebræ,* and the corresponding modifications of some of the ribs themselves,† indicated the great extinct herbivorous reptile of the Wealden to have enjoyed a double circulation, aided by a four-chambered heart as perfect in structure as that of the modern *Crocodylia*.‡ The peculiar expansion and complexity of the neural arch, so superior to the structure of that part in the Crocodile, and so distinct from the Ophidian modification of the same part in the Iguana,§ pointed to the former existence of a primary group of the class *Reptilia*, superior to and distinct from both the crocodiles and lizards of the present period. But the confirmation of the ideas and the resolution of the questions thus suggested depended on, or at least rendered very desirable, the detection of corresponding modifications of other parts of the vertebral column, and especially of that part which more immediately transferred the weight of the hinder parts of the trunk and the tail upon the—for a reptile—enormously developed hind limbs.

No sacrum of any recent or fossil cold-blooded animal had at that time been recognised as including more vertebræ than the typical number—two—in the reptilian class; and no single vertebra, or set of vertebræ, had then been referred to the sacrum of the Iguanodon. The Mantellian Collection in the British Museum, according to its catalogue, in the hand-writing of its founder, contained no sacral vertebræ. I suspected, indeed, at an early period of my investigations of our Fossil Reptilia, some detached centrums, or vertebral bodies, of a young Iguanodontoid Saurian, in that Collection, No. ¹²⁷/₂₁₂₇, *e, g*, to belong, from certain characters hereafter to be noticed, to the sacral region of the spine; but the proof, from better preserved specimens, was still wanting.

Every collection, public and private, to which I could command access, was ransacked for a specimen that might agree with the suspected characters of the great desideratum towards completing the vertebral anatomy of the Iguanodon. Some years passed away, leaving fruitless this research; until, in 1840, in the course of a systematic examination of the private collections in this metropolis, and whilst engaged in the comparison of the reptilian fossils in the well-stored museum of J. Devonshire Saull, Esq., F.G.S., in Aldersgate Street, City, my attention was arrested by a bulky and weighty mass of ankylosed and fossilized vertebræ, with a long and rather flattened bone attached to one side, the examination of which left a conviction of their agreement in general form and characters with the supposed sacral vertebræ and iliac bones of the Iguanodon in the British Museum. The following is the description of this sacrum of the Iguanodon given in the part of my 'Report,' published in 1841, where it is

* 'Report,' 1841, pp. 126, 127.

† *Ib.*, p. 133.

‡ 'Report, Brit. Foss. Rep.,' 1841, p. 203.

§ 'Hist. Brit. Foss. Reptiles,' 4to, 1850, p. 136.

compared with the sacrum of the *Megalosaurus*, which I had about the same time determined :

“This instructive specimen consists of five vertebræ anchylosed together by the articular surfaces of their bodies, and by their spinous processes, which seem to form a continuous thick median ridge of bone. The articular extremity of the terminal sacral vertebra is very slightly concave and subcircular, measuring 3 inches in both vertical and transverse diameter. The bodies of the vertebræ are compressed at their middle part, and broader below than in the dorsal region, and concave in the direction of their axis, the concavities being separated by the broad prominent convex transverse ridges formed by the anchylosed and ossified intervertebral spaces. The contour of the under part of the sacrum thus forms an undulating line. The lateral and inferior surfaces are separated by a more angular prominence of the centrum ; the under surface is less convex transversely, and the whole centrum is shorter in proportion to its depth and breadth, than in the *Megalosaurus*. The neurapophyses present the same remarkable modification in regard to their relations to the body of the vertebra as in the *Megalosaurus*, having shifted their position from the upper surface of a single centrum to the interspace of two, resting on proportions of these, which are more nearly equal, as the vertebræ are nearer the middle of the sacrum. The nerves were compelled, therefore, to escape from the spinal canal over the body of the vertebra, more or less near its middle, and impress the upper surface there with a smooth canal. The strong, vertically compressed, transverse processes, or sacral ribs, rise from the bases of the neurapophyses, and their origin extends upwards upon the spine, and downwards upon the sides of the contiguous vertebral bodies and intervertebral space : in the specimen described they are firmly anchylosed to all these parts, extend outwards, and expand to their extremities, four of which meet, join, and form an elongated tract of varying breadth, to which the ilium is firmly attached.

“The length of the largest penultimate transverse process was 5 inches 8 lines, its vertical breadth at the middle 3 inches, its thickness here 1 inch. The adjoining (last) transverse process was 5 inches in length ; the interspaces of the transverse processes equalled from $2\frac{1}{2}$ to 2 inches. The sacrum increases in breadth posteriorly ; its transverse diameter, including the anchylosed ilia taken at the posterior part of the acetabulum, is 13 inches, at the anterior part of the sacrum only 8 inches.* The proportion of the spine thus grasped, as it were, by the iliac bones, which transmit the weight of the body upon the thigh-bones, corresponds with the mass which is to be sustained and moved ; and the size and structure of the sacrum indicate, with those of the femur and tibia, the adaptation of the present great herbivorous Saurian for terrestrial life,” p. 130.

I looked forward to the more detailed description, with illustrative figures, of this unique specimen, when further worked out, as being likely to form one of the chief

* The true anterior limit of the sacrum is defined by this admeasurement.

novelties, and most important additions, to be submitted to the members of the Palæontographical Society, and other cultivators of geology, in my forthcoming 'Monographs on the Fossil Reptilia of Great Britain,' of which the 'Reports' to the British Association, in 1840 and 1841, were the basis.

In some particulars I have been aided, and in a few illustrations anticipated, by the labours of zealous contemporaries. Two associated authors, taking advantage of the indications given in my 'Report,' obtained Mr. Saull's permission to examine the sacrum of the *Iguanodon* which I had discovered, and had a drawing taken of it, which they published in the 'Transactions of the Royal Society,'* confirming, in the main, my description, but describing an attached lumbar vertebra, as a sixth sacral one.

As the characters of the order *Dinosauria* were mainly founded on this specimen four plates have, in this 'Monograph,' been devoted to the illustration of its remarkable structure.

Tab. III gives a view of the under surface, of half the natural size in linear admeasurement.

The last of the lumbar series, L, upon the interspace between which and the first true sacral vertebra the neural arch of that vertebra, *n* 1, Tab. IV, has advanced, has thereby become confluent with the sacrum proper, characterised by the junction of its transverse processes with each other, and with the iliac bones. The confluent lumbar vertebra has a much broader centrum or body, , than that of the contiguous sacral vertebra, especially at its middle part, which presents a subquadrate transverse section, the sides being vertical, excavated near the neurapophysis, and meeting the under surface at a right angle: the under surface is convex transversely, especially at its middle part, concave longitudinally. The anterior articular surface is quadrate, with the angles rounded off, and is broader than it is deep: it is slightly convex vertically, flat transversely, except near the periphery, which is convex: some remains of its water-worn and mutilated neural arch, showing the normal relation of its piers to the centrum, and its partial ankylosis to the advanced neural arch of the first sacral vertebra, are shown at *n* *n*, fig. 1, Tab. VI: the antero-posterior extent of the piers is short; the neural interspace between them and those of the first sacral vertebra is wide.

The body of the first proper sacral vertebra, *s* 1, Tab. III, differs from the foregoing by its sudden decrease in transverse diameter, especially at its middle part, the sides being concave lengthwise, and with the under surface compressed and produced into a low ridge. In consequence of the advanced position of its neural arch, the first pair of sacral nerves pass over the upper surface of the centrum about one third from its hinder end, and deeply groove that surface in their passage; the fore part of the advanced arch of the succeeding vertebra rests upon and has coalesced with the expanded hinder end of the first sacral vertebra. The transverse processes of this

* 'Philosophical Transactions,' 1849, p. 275, pl. xxvi.

vertebra, which consist of short pleurapophyses, *pl* 1, have been advanced, like the neural arch, to the interspace between the first sacral and last lumbar vertebræ, and have coalesced with both; the major part of the expanded head of the short and strong sacral rib being fixed to the sides of the expanded anterior end of its own centrum: after becoming slightly constricted, the ribs expands, like the overlapping cervical ribs in the crocodile, in the direction of the axis of the body, but the sacral ribs more firmly unite their portion of the vertebral column together by becoming confluent at their expanded extremities. Almost the whole upper surface of the short sacral rib has coalesced with a strong, vertically developed, antero-posteriorly compressed, diapophysis, *d* 1, Tab. IV. These processes are continued outwards from the whole side of the neural arch, and form a series of strong transverse ridges, *d* 1—*d* 5, Tab. IV, progressively increasing in length to the fourth, *d* 4; the fifth, *d* 5, being of nearly the same length as the fourth. The neurapophyses extend forwards and backwards beyond the base of the diapophyses, and coalesce with each other and with the centruns, so as to convert the interneural outlets for the nerves into foramina. The neural spines, probably short in comparison with those in the dorsal region, and apparently more or less blended together to form a continuous ridge, have been broken or worn away to their bases, which are indicated by the letters *n* 1—*n* 5, in Tab. IV. The bodies of the second, *s* 2, Tab. III, and third, *s* 3, sacral vertebræ are compressed, and continue to present the carinate inferior surface; that of the fourth sacral *s* 4, and fifth sacral *s* 5, progressively expand, and are convex beneath. In the first to the fourth sacral, inclusive, the sides of the centrum present a rounded depression a little behind their middle, the neural arches of the second, third, and fourth sacral vertebræ rest two thirds upon their own centrum and one third upon that in advance, dipping wedgewise into the interspaces of the centruns as they cross from one to another: the neural arch of the fifth sacral, like that of the first, rests in a larger proportion upon its own centrum, above which its piers meet, leaving a triangular neural surface before and behind their junction. The posterior articular surface of the body of the last sacral vertebra is shown in Tab. VI, fig. 2, *s* 5; it is slightly concave; the upper surface of the centrum above this end, and for about one-fifth of its length, Tab. V, fig. 2, *s* 5, is free, the neural arch of the first caudal vertebra having resumed its normal position in regard to its centrum. The posterior zygapophyses, *z'* *z'*, Tab. IV and Tab. VI, are in part preserved in the last sacral vertebra; the degree of diminution of the neural canal, as it extends, with partial expansions, through the sacral series, may be seen by comparing fig. 1 with fig. 2, in Tab. VI. The coalescence of the pleurapophyses and diapophyses circumscribes a series of four progressively expanding vertical canals on each side of the sacrum, the lower outlets of which are shown in Tab. III, and the upper ones, *o*, *o*, *o*, *o*, in Tab. IV: the nervous foramina, in the interspaces of the neural arches, open into these canals. There has been a tendency to ossification in the fascia extended between the upper borders of the strong boundaries of these foramina, of which the evidence remains, at *f*, Tab. III and IV, in a thick plate of bone, extending partly over the upper outlet of the second

foramen. The coalesced extremities of the fourth and fifth sacral ribs have been broken away on the left side. These coalesced extremities form a continuous tract of bone, *pl 1—pl 4'*, Tab. III, with a flattened outer surface, slightly concave lengthwise, to which the iliac bone is attached, and has remained attached probably through partial confluence on the right side of the present specimen. The organic architecture of this part of the vertebral column of the ancient gigantic reptile cannot be sufficiently admired in reference to the due strength of the part thereby attained.

The pressure transmitted by the thigh bones upon the iliac bones is resisted, and is transferred by the strong vertical buttresses, formed by the modified and coalesced pleur- and di-apophyses, upon the bodies and neural arches of the sacral vertebræ; but, by the altered relative position of the neural arches and pleurapophyses, the weight transmitted by one pair of buttresses does not bear exclusively upon a single vertebral centrum, but is divided equally between two centrams. In the young and perhaps more active *Iguanodon*, prior to the general ankylosis that afterwards pervades this complex mass, the further advantage of a certain elastic yielding of the parts must have been gained, by the implantation of the piers of the neural arch, and the heads of the short, buttress-like ribs, upon or over the joints between the vertebral bodies. A like advantage is gained by the same modification, in regard to the position of the neural arches and ribs, in the vertebræ of the carapace of the Chelonian reptiles, and in the sacral vertebræ of the Ostrich; the structure of the latter is interestingly analogous to that of the same part of the spine in the extinct *Iguanodon*.*

A considerable proportion of the right iliac bone remains attached to the sacrum of the *Iguanodon* above described. It is a strong, elongated, subtriangular bone, firmly adherent by an inner flattened surface to the confluent expanded ends of the five sacral ribs, *pl 1—pl 5*. The outer surface is divided into two facets by a strong longitudinal ridge, for the attachment of some of the powerful muscles of the hind limb, and a second short, oblique, almost vertical, ridge, divides the bone into an anterior and a posterior portion. The anterior portion is again subdivided into a thick, strong, acetabular portion 62—62, forming the upper part of the cavity for the hip-joint, and a more slender portion extending forwards as far as the ankylosed lumbar vertebræ, and terminating in an obtuse point, 62'. The hinder portion of the ilium, 62'', is extended backwards beyond the surface of attachment to the sacral ribs, and probably terminated freely, as in most Lacertian reptiles; but the extremity of this part has been broken off.† The chord of the acetabular arc or concavity measures 8 inches. The major part of the acetabulum was contributed, as in most modern lizards, by the ischium and pubis. Upon the whole, the structure of the ilium accords more with the Lacertian than the Crocodilian type of the bone.

* See my 'Archetype of the Vertebrate Skeleton,' 8vo, 1848, p. 159, fig. 27.

† In the Paper, 'Phil. Trans.,' 1849, by the authors who anticipated my illustrations of Mr. Saull's pelvis of the *Iguanodon*, I am stated, or at least the author of a 'Report on British Reptiles' is charged, p. 299, with having mistaken the anterior for the posterior part of the ilium. A reference to p. 135 of the

With the foregoing knowledge of the complex structure of the sacrum of the *Iguanodon*, the peculiarities of detached parts of those modified vertebræ become intelligible, and prove to be such as they were originally surmised to be.*

DETACHED BODIES OF THE SACRAL VERTEBRÆ OF THE IGUANODON, Tab. VII.

As such parts, especially the centrum or body, are not unfrequently found separated from the rest of the skeleton of immature individuals, it has appeared desirable to subjoin a description of the most common of these parts.

No. ¹²⁷/₂₁₂₇, Mantellian Collection, in the British Museum, is the centrum of a sacral vertebra of a sub-quadrate form, with a broad and flattened inferior surface, fig. 3, slightly concave lengthwise. The upper surface, fig. 4, is excavated by a wide and moderately deep canal, indicating the unusual size, for Reptiles, of the sacral portion of the spinal chord. The anterior, *n*, and posterior, *n'*, parts of the sides of this centrum, fig. 1, are raised, so as to form projecting sub-triangular rough articular surfaces, continued upon the margins of the neural canal, evidently for the attachment of the neurapophyses and the heads of the strong sacral ribs. The interspace of these anterior and posterior neurapophysial surfaces is formed by a smooth oblique groove, *o*, figs. 1, 4, connecting the smooth surface of the spinal canal with that of the free lateral surface of the vertebra, and indicating the place of exit of the sacral nerves: such outlet is necessarily in this unusual situation, because the holes of conjugation, as they exist in other vertebræ showing the ordinary position of neural arches, have here been obliterated by the impaction of the bases of the neurapophyses between the contiguous extremities of the bodies of the sacral vertebræ.

The anterior and posterior articular extremities of the present interesting fossil equally bespeak the peculiar character of the sacral vertebræ of the *Dinosauria*. They are impressed by coarse straight ridges and grooves radiating from near the upper part of the surface, fig. 2, like those on the corresponding part of a cetaceous vertebra when the epiphysial articular extremity is removed. These inequalities are here, doubtless, preparatory to that ankylosis by which the sacral vertebræ are compacted together in the mature Dinosaurs.

	In.	Lines.
The length of this vertebral body	2	10
The height	2	6
The breadth of anterior articular end	3	0
The breadth of middle part	2	2

volume of 'Reports of the British Association,' 8vo, 1842, will show how gratuitous such a statement is in regard to the 'Report on British Fossil Reptiles,' therein published. The posterior extremity of the ilium is there, as here, expressly described as the one which has been broken off; it is well displayed in the Maidstone *Iguanodon*.

* 'Report on Brit. Foss. Reptiles,' 1841, p. 130.

	In.	Lines.
Antero-posterior diameter of anterior costal surface	1	7
Antero-posterior diameter of posterior one	1	0
Breadth of spinal canal	1	5
Breadth of canal of sacral nerve	0	4

From its separated condition, the body of the sacral vertebra here described must have belonged to a young Dinosaur of a size far exceeding that of the *Hylæosaurus*. It is obviously very distinct in form from the sacral vertebræ of the *Megalosaurus*. No other reptile than one belonging to the order characterised by the peculiar structure of the sacrum already described, could have yielded a detached vertebral centrum with the remarkable modifications of the one under consideration. The modifications detected in the entire sacrum of the *Iguanodon* in Mr. Saull's collection, justify the reference of the vertebra above described to the sacrum of a young *Iguanodon*, and it was probably the fourth of the series.

CAUDAL VERTEBRÆ OF THE IGUANODON. Tab. VIII and IX.

The typical vertebræ of this region—those, viz., with hæmapophyses—are distinguished by the single hæmapophysial surface at each end of the narrow inferior surface of the centrum. The sides of the centrum are flat, or even slightly concave in the vertical direction, though less so than in the antero-posterior direction. In a caudal centrum, for example, in the Mantellian Collection, measuring 4 inches in length, and 5 inches 4 lines in depth at the middle of the side, if a pencil be laid vertically along that part, an interval of between 1 and 2 lines separates its middle part from the bone. Those equally great Wealden vertebræ which, on the contrary, have the middle of the side of the body prominent, and the lower half only converging towards the under surface, are from the tail of the *Cetiosaurus*. The posterior terminal articular surface is rather more concave than in the dorsal vertebræ; but the difference is by no means so marked as in the plano-concave vertebræ of the *Cetiosaurus*. The diapophyses* Tab. VIII, *pl d*, of the anterior caudal vertebræ are comparatively short, but strong and are continued from the base of the neurapophysis, or from the contiguous part of the centrum, or from both parts.

The hæmapophyses, or chevron bones, Tab. VIII, *h*, are not anchylosed to the centrum,

* This process, in a certain proportion of the caudal series, is of the nature of a pleurapophysis, being developed from a distinct centre, and articulated, in the young *Iguanodon*, as in the young *Crocodile*, by suture to the rest of the vertebra. In succeeding vertebræ the homologous part is an exogenous process, which gradually subsides to a ridge, where it is of the nature of a diapophysis; and under such name, with the above explanation, it seems to me most convenient to distinguish the transverse process of the caudal vertebræ.

but articulate with two contiguous vertebræ, crossing, and being somewhat wedged into, the inferior interspace of those vertebræ; in two of the caudal vertebræ of the Maidstone *Iguanodon*, there are two closely approximated hæmapophysial surfaces, but in general the hæmal arch articulates with a single oblique triangular surface on each of the contiguous extremities of the co-articulated vertebræ; the hæmapophyses being here confluent at their vertebral as well as at their distal extremities.

A caudal vertebra exhibiting this modification, in Mr. Holmes's collection, measures, in the vertical diameter of the articular surface, 4 inches 9 lines; in its transverse diameter, 4 inches 6 lines; the breadth of the inferior surface of the vertebra is 3 inches 3 lines. The interspace between the anterior and posterior hæmapophysial surface is 9 lines; it is concave in the axis of the vertebra. The diameter of the spinal canal is reduced in this vertebra to 9 lines. The transverse processes are of very small size. The spinous process is broken off. We have seen that those of the sacral vertebræ appear to have been short. There is reason to think that the spinous processes increased in length for a certain distance as they receded from the sacrum, and then diminished. Thus, in a caudal vertebra (No. $\frac{130}{2130}$, Mantellian Collection, Brit. Mus.), evidently anterior in position, by its size, by its oblique processes, and by the place of development of its transverse processes from the base of the neural arch, the spinous process is 5 inches in height, while in the six caudal vertebræ preserved in natural sequence and relative position in the Mantellian Collection, the spines are more than double that height, Tab. VIII. That the vertebra (No. 2130) is not a more posterior caudal vertebra from a larger *Iguanodon* is shown by the relative thickness, as well as position, of its transverse processes, as compared with the six caudal vertebræ above mentioned, for their transverse processes sensibly diminish in every diameter, and especially in vertical thickness, from the first to the sixth; and, moreover, it is evident that, in this short series, the spines decrease in height both forwards from the third, as well as backwards, but more so in the latter direction. Thus the spine, *ns*, of the first of these vertebræ is 14 inches high, of the third 15 inches, and of the sixth 13 inches. These spines increase in breadth toward their summits, which are truncated, and in contact with each other, partly from this expansion, partly from the posterior ones being slightly bent forwards. One cannot witness this change of character in so short a segment of the tail without a conviction that this appendage must have been relatively shorter than in the *Iguana*.

The first spine, besides being somewhat shorter, is more rounded off at its anterior margin than the third, a difference which is still more obvious in the detached caudal (No. 2130) above described; but above its origin a thin trenchant plate is extended for a short distance from the middle of the anterior margin: this character, which calls to mind one that is present in a greater proportion of the vertebral column in the *Crocodylians*, is more strongly developed in the second and third vertebræ. The neurapophysial suture is more nearly obliterated in the sixth than in the first of this

instructive series, or in the more anterior and detached caudal vertebræ. The following are the dimensions of the detached anterior caudal (No. 1), and of the first (No. 2) and last (No. 3) of the series of six :

	No. 1.		No. 2.		No. 3.	
	<i>In.</i>	<i>Lin.</i>	<i>In.</i>	<i>Lin.</i>	<i>In.</i>	<i>Lin.</i>
Antero-posterior diameter of centrum	2	8	2	8	2	7
Vertical diameter of articular surface	3	6	3	3	2	6
Transverse diameter of articular surface	3	5	3	2	2	6
From under part of centrum to upper end of } posterior zygapophysis }	5	6	5	8	4	0
From upper end of posterior zygapophysis to } the summit of spine }	5	0	14	0	10	6
Antero-posterior diameter of base of spine	1	3*	1	7	1	4
Antero-posterior diameter of summit of spine	2	0	2	2	2	6

The chevron bones, of which three are preserved in the slab containing the six caudal vertebræ, Tab. VIII, *h, h*, exhibit the perforated character, *ib. H*, which distinguishes them from those of the *Cetiosaurus* and of all existing Crocodiles and Lizards, not excepting the Iguana, in which the hæmapophyses are ankylosed at their distal or spinal end only, and remain separate and articulated to two distinct surfaces, at their proximal ends. The length of the superior and inferior vertebral spines, and the shortness of the transverse processes, prove the form of the tail to have been flattened laterally, and of great breadth in the vertical direction, at its basal portion at least.

The bases of the neurapophyses, *n, n*, are nearly co-extensive lengthwise with the centrum, *c*, and expand transversely so as nearly to meet where they rest upon the centrum, but they do not quite circumscribe the neural canal. They contract rapidly in antero-posterior extent, forming the notches of the conjugational foramina, or nerve-outlets, of which the posterior notch is the deepest.

DETACHED CAUDAL VERTEBRA OF THE IGUANODON. Tab. IX.

The characteristic and well preserved caudal vertebra obtained by Mr. G. B. Holmes, from the Stammerham quarry of Wealden Stone, near Horsham, Sussex, is represented in different points of view in Tab. IX, two thirds the natural size. Fig. 1 gives a side view, showing the slightly concave almost flat surface of the side of the centrum; these lateral surfaces converge towards the under surface, the anterior and posterior angles of which are, as it were, truncated for the articulations, *h* and *h'*, of the confluent bases of the hæmapophyses; the diapophysis, *d*, springs out from near the back part of the vertebra, about the line of suture of the centrum *c*, and neural

* The anterior basal ridge of this vertebra is broken away.

arch n ; the base of this arch equals about two thirds of the antero-posterior extent of the centrum to which it is attached, a little nearer the anterior than the posterior end. The arch sends forwards a pair of long zygapophyses, z , whose articular surfaces look inwards and a little upwards; a low ridge traverses two thirds of the summit of the arch, fig. 2, from the hinder third of which springs the neural spine, $n s$, which slightly gains in antero-posterior extent as it rises: but its summit is broken away: the posterior zygapophyses z , fig. 1, project from the back part of the base of the spine: their articular surfaces look outwards and a little downwards.

The figure 2, of the vertebra, viewed from above, shows the form and extent of the summit of the neural arch, which is rarely preserved in fossil vertebræ. Fig. 3 shows the anterior, and fig. 4 the posterior, surface of the vertebræ; the articular ends of the centrum are very slightly and irregularly concave, with the margin thickened and rounded off. The under surface of the centrum, fig. 5, is characterised by a median groove or channel between two parallel ridges which extend from the anterior h to the posterior h' hæmapophysial surfaces. Of these the posterior one is the largest.

The neural canal, figs. 3 and 4, n , is contracted; its area is a full transverse oval.

With respect to the terminal caudal vertebræ in which diapophyses and hæmapophyses have ceased to be developed, no specimen of *Iguanodon* has yet been discovered in which any such vertebræ have been so associated with the rest of the skeleton as to enable the conscientious observer to determine their character as unequivocally belonging to the *Iguanodon*. Two vertebræ, from the Wealden, near Battle, in the Museum of the Royal College of Surgeons, in which the diapophysis has subsided to a longitudinal ridge, crossing the upper third of the centrum in the smaller specimen, have been described in the 'Catalogue' as probably belonging to the *Iguanodon*; for it is most probable that the typical form of the body of the *Iguanodon*'s vertebræ is modified or lost in such terminal and rudimental vertebræ; but as these are, in every case, the least characteristic bones of an extinct animal, their loss is of the least consequence, and any positive affirmation regarding them, on imperfect evidence, becomes the more gratuitous.

SKULL OF THE IGUANODON.

Tympanic Bone. Tab. X.

Of the bones of the head of the *Iguanodon*, the characteristic one above named, a fragment of the upper jaw, and a larger proportion of the under jaw have been brought to light: the portions of the jaws, at least, are demonstrably those of the present species of herbivorous reptile, by the teeth which they contain: the great *Cetiosaur* and *Streptospondyl* may possibly have afforded the specimen figured in Tab. X, which, in

the Mantellian Catalogue of the Fossils purchased by the British Museum, is assigned to the *Iguanodon*.

A reptile with vertebræ and ribs resembling in their chief characters those of the amphotyrian Crocodiles, and with distinctive peculiarities, in which the Lacertians by no means participate, might reasonably be conjectured to resemble the Crocodiles in the form of the tympanic bone; and if the reptile in question used its teeth for masticating hard vegetable substances, we might with more reason expect that the bony pillar, supporting the lower jaw, should be firmly and immoveably fixed through its whole length, like the tympanic bone of the Crocodilians, and not be loosely suspended to the skull by a single extremity, as in the Iguana and other Lacertians. A very remarkable bone, discovered in the Tilgate strata, figured by Dr. Mantell in the 'Geology of the South-east of England,' pl. ii. fig. 5, the resemblance of which to the "os quadratum," or tympanic bone of birds, was first suggested by Dr. Hodgkin, is assigned to the *Iguanodon* by Dr. Mantell. He describes it "as forming a thick pillar or column, which is contracted in the middle, and terminates at both extremities in an elliptical and nearly flat surface." In the Iguana and other reptiles the lower end of the tympanic bone is terminated by a convex trochlea, which is received into a corresponding cavity in the lower jaw; and it may be asked:—Is the modification of the bone in question, assuming it to belong to the *Iguanodon*, indicative of a peculiarity of the joint of the lower jaw as remarkable as the structure of the teeth, and correlated to their masticatory uses? "Two lateral processes, or *alæ*," Dr. Mantell proceeds to state, "pass off obliquely, and are small in proportion to the size of the column; on placing these bones beside the os tympani of an Iguana, we at once perceive that the relative proportions of these parts are reversed; for in the recent animal the pillar is small and the lateral processes large. From the great size of the body of the fossil, and the extreme thinness of its walls, the *tympanic cellulae* must have been of considerable magnitude, and have constituted a large portion of the auditory cavities. Pl. ii. fig. 1, (fig. 5 is meant,) accurately represents the most perfect specimen in my cabinet; it is 6 inches high, and $5\frac{1}{2}$ inches wide at the longest diameter of the extremity of the body. It exceeds in magnitude the corresponding bone of the *Mosasaurus*, and is fourteen times as large as the same bone in an Iguana 4 feet long." Tab. X, p. 306.

After a careful inspection of the specimen, as it now may be seen at the British Museum, I have come to the conclusion that both extremities have been abraded or fractured: and that the form of the articular surface is not unequivocally demonstrated at either end. The parts described as "two lateral processes" appear to be the two piers *a*, *c*, of the auditory arch of the tympanic, which arch is composed of a broad thin plate of bone, and surrounds the "foramen auditorium externum," *e*, which is of a narrow oval form. Although the shape of this bone indicates that it was much less susceptible of movement than the tympanic bone usually is in Lacertian reptiles,

there is no appearance of a sutural attachment in its longitudinal extent, with a parallel and co-extensive squamosal bone, as in the Crocodilia: the points of connection seem to have been restricted to the two expanded extremities.

LOWER JAW OF THE IGUANODON. Tabs. XI, XII, XIII.

At the beginning of the year 1848, Mr. George B. Holmes, of Horsham, obtained from the Stammerham stone-pit, or quarry, of Wealden, near that town, the right ramus of the lower jaw of a young Iguanodon, which is figured of the natural size in Plates XI and XII.

The accurate and beautiful drawings made by his daughter, Miss G. M. Holmes, from which these plates are engraved, were most liberally transmitted to me, at that time, for description. Learning, however, from Dr. Mantell, when I was about to communicate that description to the Geological Society, that he also had just received from Captain Brickenden, of Warminglid, Sussex, the lower jaw of a larger Iguanodon, which he was desirous to describe for the Royal Society of London, I declined to use the materials with which Mr. Holmes had favoured me, until Dr. Mantell's observations had appeared. His Memoir was accordingly published in the 'Philosophical Transactions,' Part II, 1848.

The most remarkable conclusion to which the author of that Memoir arrived, after a study of the above materials, was, that the Iguanodon had been endowed, not only with fleshy or muscular lips,* hitherto believed to be the peculiar characteristic of the mammalian class amongst air-breathing vertebrate animals, but with such lips greatly developed.†

The correlation or association of such muscular and sensitive appendages to the jaws with the necessity of deriving lacteal nourishment by the act of suction, during the infancy of the animal, has hitherto been so constant and exclusive in the air-breathing vertebrates, that a transition from the Reptilian to the Mammalian class, by the conjunction of fleshy lips with a scaly skin and cold blood, would be a most unexpected and extreme exception to one of the best established generalizations in Comparative Anatomy.

I shall, first, give a description of the portion of jaw from Stammerham, then compare it with the larger jaw obtained from Tilgate Forest, and finally endeavour to

* "The great size and number of the vascular foramina, &c., indicate the great development of the integuments and soft parts with which the lower jaw was invested." p. 197.

† "The sharp ridge bordering the deep groove of the symphysis, in which there are also several foramina, evidently gave attachment to the muscles and integuments of the under lip; and there are strong reasons for supposing that the latter was greatly produced, and capable of being protruded and retracted, so as to constitute, in conjunction with a large fleshy prehensile tongue, a powerful instrument," &c., p. 197. The author proceeds to infer from "the edentulous and prolonged symphysis, and the great development of the lower lip and the integuments of the jaws, as indicated by the number of vascular foramina, a striking analogy to the edentata." *Ib.*, p. 198.

deduce such conclusions as to the nature of the soft parts that covered the lower jaw, as the characters of that bone may legitimately sustain.

The subject of Tab. XI, XII, is the dentary piece of the right moiety or ramus of the lower jaw. It is chiefly remarkable for the straightness and parallelism of the upper, *a b*, and lower, *c d*, borders, for the portion which the dentary piece contributes to the suddenly rising coronoid process, *f*, and for the abrupt slope downwards, at an angle of about 45° , of the short, edentulous, compressed anterior part of the bone, *b*, to the shorter symphysis, *e, d*, fig. 1; which latter part of the bone projects a little below the lower level of the ramus. The exterior surface of the ramus is, vertically, a little concave where it forms the alveolar wall, and then becomes moderately convex to the thick and rounded lower border, Tab. XII, fig. 4. A few foramina, *g g*, fig. 1, open at irregular intervals, in a longitudinal series, upon the concave part of the outer surface of the ramus, from 5 to 6 lines below the alveolar border; and a few foramina occur parallel with the sloping border, *b c*, at a similar distance from it. The general surface of the bone on the outer side of the jaw is smooth, but becomes more irregular near the symphysis; it presents several lines of fracture, but rises to form the coronoid process, *f*, without any trace of the suture which separates the coronoid from the dentary piece in the jaw of the Iguana. The relative position of that suture, indeed, to the termination of the dental series, in the Iguana, is such that the suture could not be repeated in the Iguanodon, so as to include the coronoid process, because the dental series is continued backward along the inner side of the base of that process. In the form, extent, and direction of the coronoid process, it closely resembles that of the Iguanodon, at least as regards so much of the process as is contributed in fossil by the dentary piece. If its extent were added to by a true coronoid element articulating with it behind, it would resemble the broader coronoid of the *Cyclodus* and *Varanus*. The presence of the process, though formed in an unusual way in the Iguanodon, gives the jaw a lacertine character, and makes it differ in a striking degree from that of the *Crocodylia*. It remains to be seen, however, in more complete specimens, whether the coronoid piece actually contributes any share to the process, or whether it be restricted, as in the Crocodylian reptiles, to the inner surface of the ramus, bounding the fore part of the wide entry to the mandibular canal.

The inner side of the dentary element of the mandible of the Iguanodon, Tab. XI, fig. 2, displays, as in the *Lacertia* generally, the alveolar recesses, and such traces of the teeth themselves as may have been preserved, which in the present case are limited to a few more or less advanced germs of successional teeth. This aspect of the jaw shows that the dentition of the great extinct herbivorous reptile was of the "pleurodont"* type, as in the Iguana and many other modern lacertine genera.

* 'Odontography,' p. 240; the term signifies the attachment of the teeth to one side or parapet of an open alveolar groove.

Eighteen alveolar fossæ for the lodgement of the contracted sub-cylindrical bases of the teeth are exhibited in Mr. Holmes's specimen; but all the teeth that were fully developed and had occupied those semi-cylindrical depressions have been lost. Greater or less portions of the protruding summits of six successional teeth are seen below the alveolar grooves of the old teeth, and of so much larger size as indicates a more rapid growth of the young *Iguanodon*, than in modern reptiles. In the different proportions in which the young teeth are developed, may be discerned an illustration of the same law of preservation of an adequate proportion of an ever changing series of masticatory organs, which is illustrated by the condition of the dental series in many modern reptiles and fishes. The teeth marked *k, k, k*, for example, of which the summits of the crown have but just begun to be calcified, alternate with those marked *l, l, l*, fig. 2, Tab. XI, in which the crowns are more advanced. One may see by the size of these teeth that they are destined for work in a larger jaw than that of the young *Iguanodon* in which they are cradled; one may likewise discern the unfitness of the actual alveolar grooves for the reception and retention of the large successional teeth, and thence rightly infer that the bone grows and goes with the growth and disappearance of the teeth themselves; the alveoli of the shed teeth being progressively absorbed as the osseous bed of the new teeth rises along with them. The same concomitant growth of the jaw-bone and the teeth has long been recognised in the mammalian class, and is strikingly exemplified in the elephant, in which the large complex molars succeed each other from behind forwards.

The surface of the jaw below the alveolar groove is smooth, but is traversed by a deeper and narrower groove continued from the entry of the mandibular canal, *i*, forwards just above, and nearly parallel with, the lower border of the ramus, becoming shallower and descending to that border as the groove, *d*, approaches the symphysis, *s*; the major part of this groove was probably covered by the splenial element, (opercular of Cuvier), in the entire ramus of the *Iguanodon*'s jaw. Above the groove the inner surface of the dentary is slightly convex at its posterior half, and slightly concave at the anterior half. The edentulous, narrow, sloping margin of the jaw, *b, e*, has a slightly tumid roughness along its inner side, as if for the firm attachment of a callous covering in the recent animal. The actual symphysis of the jaw is about two thirds of an inch in extent, and a quarter of an inch in greatest depth, almost horizontal in position, but bent, with the concavity looking upwards; the inferior and anterior angle of the jaw, *a*, projects a little way beyond the fore part of the symphysis, and the back part of the symphysis is impressed with a longitudinal groove, fig. 2, *s*, parallel with, but above, the anterior end of the mandibular groove, *d*.

In the small extent of the mandibular symphysis the *Iguanodon* resembles the *Lacertilia*, and differs from the *Crocodylia*, even from the true crocodiles and alligators in which the symphysis is much less than in the gavials; but the position of the symphysis at the lower end of the anterior termination of the ramus, and the sloping

edentulous character of that part are peculiarities in which the *Iguanodon* differs from all known modern reptiles.

Another character by which the *Iguanodon* differs from modern lizards, and especially from the *Iguana*, is the contour of the alveolar plate viewed from above, as in fig. 3, Tab. XII; it is thus seen to describe a gentle but graceful sigmoid curve, convex inwards at its hinder two thirds, straight in the rest of its extent, or slightly concave inwards, as continued by the edentulous symphysis. In the *Iguana* the hinder four fifths of the alveolar plate is straight; it bends inwards to the symphysis of the jaw at its anterior part. The form of the thick rounded lower border of the jaw of the *Iguanodon* is shown at fig. 4, pl. xi.

In the *Iguana* the mandibular groove runs nearer the base of the alveolar plate than the lower border of the ramus, and stops short before it has reached the middle of the dental series: in the *Varanus* the same groove extends from the anterior termination of the splenial piece along the lower border of the ramus as far as the symphysis; in regard to this groove, therefore, the *Iguanodon* resembles the *Varanus* and also the *Cyclodus* more than it does the *Iguana*. In the *Crocodyles* one sees only an oblong foramen at the fore-end of the splenial element. The inner plate or wall of the dentary bone in the *Iguanodon* bifurcates behind, as in most reptiles, where it articulates with the splenial, angular, and coronoid elements; the upper branch is shown at *b*, the lower one at *c*, fig. 2, Tab. X. What may have been the length of the entire jaw, as completed by the splenial, angular, surangular, and articular elements, must remain conjectural, until either this part of the mandible, or an entire upper jaw with the tympanic part of the same cranium, may be discovered.

In the *Iguana* the dentary element forms about three fifths of the length of the lower jaw; in the *Cyclodus* it forms rather more than half, in the *Varanus* a little less than half of the lower jaw; in the *Crocodyles* it forms more than two thirds the length of the jaw.

As the dentary piece in the *Iguanodon* itself contributes to the formation of the coronoid process, it is probable that the entire jaw may more nearly resemble the *Crocodylian* than the *Lacertian* type in the proportion of the ramus formed by the dentary element.

The length of the corresponding element of probably a mature *Iguanodon*, figured in the 'Philosophical Transactions' for 1848, and now in the British Museum, is 21 inches; its vertical diameter, in a straight line, where the alveolar wall is best preserved, is 3 inches, 7 lines, so that it is relatively deeper than in the younger *Iguanodon*, and this probably in reference to a deeper implantation of the large teeth of mature age, and to the greater strength of the jaw required for the more vigorous mastication at that period of life. The coronoid process, Tab. XIII, *f*, being a part of the dentary bone, has also been preserved with the rest of that element in Capt. Brickenden's specimen, and shows the same abrupt curve upwards. The nervo-vascular foramina are

more numerous than in the younger jaw, but are arranged, as in that jaw, along the outside of the alveolar wall, beginning near the base of the coronoid process, and extending down the edentulous sloping part of the jaw; their size is exaggerated in the figure given in the 'Philosophical Transactions,' and there is no particular anterior foramen, larger than the rest, and meriting, as in the mammalia, the name of "foramen mentale." The exterior marginal groove of the edentulous border is better marked in Capt. Brickenden's than in Mr. Holmes's specimen, but the alveolar wall has suffered more injury in the Tilgate specimen than in that from Stammerham; in the latter, indeed, it seems to be entire, and so much of the thin inner border is preserved as to show that there was not any internal alveolar wall co-extensive with the outer one. I cannot discern evidence of more than 18 dental depressions on the outer alveolar wall of the large lower jaw from Tilgate; the number, therefore, is the same as in the specimen from the younger Iguanodon, just as we find the same number of teeth in the same species of Crocodile at all ages of the individual, no additional teeth being added to the series from behind, like the true molars in the Mammalia, in the course of the change of dentition as the animal advances to maturity. So much of the inner surface of the dentary bone as is preserved entire in the Tilgate specimen, corresponds with the same portion in the younger specimen from Stammerham; no part is absolutely flattened: the part sustaining the upper division of the mandibular canal has been broken away.

If we pass now to the consideration of the inferences as to the nature of the soft or perishable teguments of the jaw, which are deducible from the characters of the bone itself, it may be first remarked, that the disposition of the vessels and nerves, supplying such teguments, differs according to their nature in different existing air-breathing vertebrate animals, and the jaw-bone exhibits corresponding differences in relation to such modifications of the mandibular vessels and nerves. To those who may not have ready access to Cabinets of Comparative Osteology, a glance at the plates of the well-known and widely distributed 'Ossements Fossiles,' of Baron Cuvier, will show that the rami of the lower jaw in Mammalia usually present one large, rarely two or three, foramina, on the outside of each ramus at its fore-part; but that, in reptiles, as may be seen in the Crocodiles, Pl. 1; the Lizards, Pl. 16; the Tortoises, Pl. 11;* the nervo-vascular foramina are more numerous, smaller, and arranged, in a more or less linear series along nearly the whole extent of the outside of the ramus of the jaw.

The first modification relates to the concentration of the nervous and vascular influences upon thick, muscular, soft, sensitive, extensile and retractile lips, covering the jaws, and extending beyond their fore part, where such lips are most developed. The second modification relates to a more diffused and equable supply of the nervous and vascular, but especially the latter, influences, to salivary follicles opening along the

* The 4th edition, 1824, tom. v, pt. ii, is here cited.

alveolar parapet, and to rapidly worn and renewed horny scales covering the outside of the rami of the lower jaw. The like differences of the condition of the soft parts external to the upper jaw govern corresponding modifications of the nervo-vascular foramina of the bones of that part. It will be obvious, on the slightest reflection, that the horny scales or scutes covering the borders of the jaws in reptiles must be those that are subject to most abrasion, moistening, and other influences accelerating their decay; and in the living Saurians it may be generally seen that the marginal scales or scutes of the jaws exhibit the effects of such destructive influences contingent on their position. As these scales are more quickly worn away than those of other parts, so they are more rapidly renewed; their progress of growth is quicker, and their formative beds in the cutis have a greater supply of both vessels and nerves: the greater vascularity of this part of the integument is shown by injecting the head of a crocodile or lizard, and macerating away the cuticular scales. The labial muco-salivary follicles are arranged commonly in a linear series, and their orifices may be seen in a row along the narrow and shallow groove between the alveolar border and the scaly integument forming the margin of the mouth: these follicles, in most Saurians, perform the offices assigned to the more compact and localized salivary glands in Mammalia; and consequently require and exhaust a good supply of blood. The arteries emerging from the serial foramina resolve themselves each into a brush of small branches which are spent in the vascular matrices of the labial scales and on the secreting surfaces of the labial glands.

In the great *Mosasaurus*, as is shown in Pl. XVIII, of the 'Ossements Fossiles,' of Cuvier,* the linear series of nervo-vascular foramina along the outside of the ramus of the lower jaw indicates plainly that such jaw was covered by a firm scaly integument protecting a long series of muco-salivary follicles, as in existing Saurians. In the great *Megatherium* and *Mylodon* the single or double large nervo-vascular outlets confined to the fore part of the mandibular rami equally attest the existence of fleshy and sensitive lips produced beyond the fore part of the jaw, and capable of being further protruded and retracted.

It needs only a comparison of the lower jaw of the *Iguanodon* with that of the *Mosasaurus* and of any recent reptile, and with that of the *Megatherium* and of any recent Mammal, to arrive at a correct conclusion as to whether the *Iguanodon* resembled the Saurians in the covering of its jaws, or presented the monstrous combination of mammalian lips with a reptilian skeleton.

I have only to add that the form of the anterior termination of the jaw of the *Iguanodon* is diametrically opposite to that of the *Mylodon*: in the former, the upper border slopes downwards and forwards at an angle of 45° to the straight inferior border; in the latter the inferior border bends upwards and forwards at nearly the same angle to the straight upper border. In the reduced figure of the lower jaw of

* Ed. 4to, 1824, tom. v, pt. 2.

the Iguanodon in Pl. XVII, fig. 4, of the memoir above quoted in the 'Philosophica Transactions' for 1848, the nervo-vascular foramina are not diminished in the same proportion as the jaw itself: they are accurately delineated both as to number and size, in Tab. XIII, fig. 1, *g, g*, of the present Monograph. The angle, also, at which the two rami of the lower jaw are conjecturally united in Pl. XVII, 'Phil. Trans.,' 1848, is much too acute; and the restoration of the lower jaw in the Mantellian collection, British Museum, accordingly leaves a transverse space equalling little more than one half the breadth of the upper jaw, to the description of which I next proceed.

FRAGMENT OF THE UPPER JAW OF THE IGUANODON. Tab. XIII, figs. 2, 3, 4.

After the tympanic bone and lower jaw, the most instructive and intelligible part of the skull of the Iguanodon, as yet obtained, is a portion of the upper jaw, consisting of so much of the back part of the left superior maxillary bone, with the alveolar groove, as includes ten dental recesses, seven of which contain teeth. This specimen was washed out of the submerged Wealden deposits off Brook Point, Isle of Wight, and is now in the British Museum.

The alveolar groove opens widely and obliquely upon the inner and under aspect of the fragment, *a, a*, fig. 3: the outer side or parapet, fig. 2, is formed by the chief osseous mass with the outer compact wall of the jaw, fig. 4, *b, b*; this wall sends off from its upper and outer side a process, *m*, directed backwards and a little outwards, with the end broken and blunted by attrition, or water-worn; the bone is then continued backwards, slightly expanding in the vertical direction, and terminating in a point, *p*, also obtusely rounded by attrition subsequent to fossilization. Both this extremity and the malar process show unequivocal evidence of sutural surfaces upon their outer and upper side; that upon the malar process is oblong and depressed; that upon the upper and outer part of the hinder end of the maxillary is broad, oblique, and divided into two parts by a longitudinal elevation. Between this extremity and the malar process the canal, *c*, for the nerves and vessels of the upper jaw enters the substance of the bone, immediately above the deep rounded groove that divides the process from the body of the bone; a fossa is continued forwards above the canal, for an inch and a half, in advance of the entry of the canal, and continues the separation of the process from the body of the bone in that direction.

The smaller anterior end of this fragment is of a trihedral figure; the inner and under side is formed by the dental groove, the inner and upper side is flat; the outer side is slightly convex. At the angle where the last two sides meet there is a narrow sutural or fractured surface continued forwards from the sutural depression upon the upper part of the malar process. A transverse section of the anterior extremity of the fragment, fig. 4, taken through the foremost tooth, 1, and its successor, 2, shows com-

compact bone from three to four lines in thickness, forming the outer surface, *b*, *b*, and a similar layer from one to two lines thick, forming the inner surface, *i*, and increasing to near three lines in thickness, where it bends down to form the shallow inner boundary of the alveolar groove, *z*, *a*; the compact substance is not continued over the alveolar groove itself; the intermediate substance is an areolar osseous tissue, the meshes being most open along the inner and upper surface of the bone. The maxillary canal, *c*, exposed in this section is nearer the outer surface; it measures 14 lines by 8 lines in its diameters, sending off branches which perforate obliquely, outwards and forwards, the compact outer wall of the jaw. Of the three oval nervo-vascular foramina, *g*, *g*, preserved in the present fragment upon the outer surface, two are 4 lines, and the third 3 lines in long diameter; they are included in a space of 16 lines, are situate about an inch above the worn outer border of the alveolar groove, and are the last three of the series of such foramina. They correspond nearly in size and relative distance from the alveolar border with those at the back part of the similar series of nervo-vascular foramina in the lower jaw of the *Iguanodon*; and like them the obliquity of their course indicates the relation of the fragment to the anterior and posterior extremities of the jaw. The corresponding foramina are present on the same part of the bone in the more mutilated homologous portion of a dentigerous bone of the *Iguanodon* figured in Dr. Mantell's 'Memoir,' above quoted, Pl. XIX, and equally prove the part to which those orifices incline as they open outwards to be the anterior end of the fragment, and not the posterior end, as the anatomist conjectured of whose aid Dr. Mantell availed himself in the interpretation of this fragment.

The vertical extent of the slightly convex outer surface of the maxillary, in front of the malar process, in the present fragment, is 3 inches, but a portion has been broken away from the border, to which the smooth and flat inner surface of the maxillary converges as it ascends; it is possible, therefore, that the outer wall of the maxillary of the *Iguanodon* may have been continued relatively as high vertically as in the *Iguana*, *Varanus*, *Tejus*, and most other Lizards: anterior to this broken upper surface is a portion of a wide smooth depression, or of a canal laid open.

The alveolar groove, as it extends backwards, curves outwards, in the same degree as the alveolar groove does at the same part in the lower jaw, Tab. XII, fig. 3. The extent of the alveolar groove in the present fragment of the upper jaw is 8 inches; the antero-posterior diameter of the crown of the largest tooth is 1 inch; it seems to answer, therefore, to the posterior half of the dentary part of the lower jaw of the *Iguanodon*. The first tooth, 1, is a fully developed or old one, with its cement-covered base apparently continuous or confluent with the cancellous bottom of the groove, *a'*. The crown of the tooth, 2, which is about to succeed it, and which has in part undermined and excavated the old tooth, is on the inner and posterior side of its base; the crown of the new tooth is widely and deeply excavated, as shown in the section, fig. 4, 2, where the hollow base of the crown has suffered a slight fracture and displacement:

a thin layer of dentine has been formed beneath the enamel; the mineral matter now occupies the place of the original vascular pulp of the dental matrix. The flattened side of the crown of this tooth is turned towards the outer alveolar wall, the convex surface looks inwards and downwards; in the lower jaw the teeth, Tab. XI, fig. 2, *1, 1*, have the reverse direction, as stated in Dr. Mantell's Memoir on the lower jaw, from Tilgate.* Next, behind the young tooth, 2, is the recess from which an old tooth has been expelled; and behind the recess is a fully formed crown of a tooth, 3, with the beginning of the fang, which tooth had come into use, but its grinding surface has been worn down by the rolling of the fragment after fossilization and extrication of the specimen from the matrix; a narrow recess follows this tooth, and then comes the fang and base of the crown of an old tooth, 4, partly undermined, and about to be pushed out by the crown of a successor, 5; next follows an empty recess; then the base of apparently a fully developed tooth, 6, the projecting crown of which has been broken away; close behind this tooth is the base of a narrower and smaller tooth, 7, followed by the recess for a similar sized tooth, which terminates the series.

We thus see that, as in the lower jaw of the Iguanodon and in the upper jaw of the Iguana and Tejus, the teeth decrease in size at the hinder end of the series; and that this end of the series in the Iguanodon inclines outwards, as does the same end of the alveolar series in the lower jaw, to which it was opposed.

As a similar portion of bone, recognised by Dr. Mantell as a "fragment of the upper jaw of an Iguanodon," when first discovered in 1838, in a quarry near Cuckfield, has been referred to the opposite end of the jaw, in the Memoir in which it is figured, 'Philosophical Transactions,' 1848, Pl. XIX, pp. 190, 191, with an appeal to the osteology of the recent Iguana, as confirmatory of that determination, I may be excused for concluding by a summary of the facts which seem to me to determine rightly the nature and relative position to the rest of the skull of the present very interesting part of the fossilized skeleton of the Iguanodon. The size of the teeth forbids the supposition that the fragment in question can have formed part of a pterygoid or palatine bone,—such a dentigerous bone, viz., as is shown in the skull of the Mosasaurus and, amongst existing Saurians, in the Iguana: both the shape of the pterygoid and the relative size of the teeth discourage the idea that the present fragment can be part of the homologous bone: it would be contrary to all known analogies to refer it to the palatine bone; and there remains, therefore, only the superior maxillary bone with which to compare it. Of this bone the specimen is evidently that part or extremity containing a natural termination of the alveolar groove; this is shown by the suddenly diminished size of the teeth and alveoli, and by the portion of bone, *p*, fig. 2, which is continued beyond the last alveolus.

The question next arises:—Does the fragment include the anterior or posterior end of the alveolar groove? In answer to this I may first remark, that the outer and inner

* Philos. Trans., 1848, p. 187.

sides of the fragment are determined by the relative depth of the walls of the alveolar groove, and by the relative position of the new and old teeth. In no pleurodont lizard is the deeper wall the innermost; and in no lizard or crocodile does the germ of a successional tooth appear on the outside of the base of the one it is about to succeed. The philosophy of Zootomy compels one to be guided by so great a number of observed instances, as is implied by the above generalized statement, as by a rule; and we know that the lower jaw of the *Iguanodon* conforms to that rule, by direct observation. In the upper jaw of the *Iguanodon* the successional tooth-germ is not situated directly on the inner side, but is also behind the tooth about to be displaced, at least in most of the specimens in the present fragment.

The extremity of the alveolar series, therefore, exhibited in the present fragment, must be either the fore end of the right maxillary bone or the back end of the left maxillary bone. The expansion and bifurcation of the bone, as it approaches towards the end of the alveolar series, are opposed to every analogy presented by the fore part of the maxillary in the Lacertian and Crocodilian reptiles. The foramina, grooves, and sutural surfaces become utterly unintelligible in this supposition; which is opposed, moreover, by the direction of the nervo-vascular outlets on the outer side of the bone, and by the curvature of the extremity of the alveolar series, as compared with the anterior extremity of that series in the lower jaw. In favour of the conclusion that the fragment in question is from the back part of the upper jaw, the expansion of the bone as it recedes from the triedral fractured end, *a, a'*, the direction of the nervo-vascular outlets, *g, g*, the altered direction of the alveolar groove, inclining, *e. g.*, outwards to be adapted to the hinder curve of the alveolar groove of the lower jaw, and the diminished proportions of the teeth at its obvious termination, all concur. And I may add that, supposing the *Iguanodon*, like the *Iguana*, to have had the dental series of the upper jaw prolonged forwards upon a premaxillary bone, the alveolar series of the maxillary would have been continued nearer to the end of the bone, and would have terminated more abruptly than it does in the present fragment.

Thus conducted to the conclusion that we have in the fragment in question the hinder part of the left superior maxillary bone, we have evidence that the *Iguanodon* differed (as, indeed, from the important differences in other parts of the skeleton might have been expected) from the *Iguana* and the Crocodiles, in having the alveolar end of the upper jaw produced backwards, beyond that outstanding backwardly inclined process, which gave attachment to the malar bone, such backwardly produced dentary end of the bone corresponding with that end, in the existing reptiles above cited, which articulates with the ectopterygoid ("os transverse" of Cuvier).

The dental series, thus brought more beneath the cranial part of the skull, would be more favorably placed for the operations of the masticatory muscles inserted into the lower jaw, and the backward prolongation of the dentary element, where it is developed into a coronoid process, is a departure from the ordinary reptilian structure

of the lower jaw, in itself significant of some correlative modification of the upper jaw. So far as the valuable fragment in question illustrates the nature of that modification, we discern in it an approximation to the mammalian type of the superior maxillary bone, subservient probably to a greater development of the homologue of the masseter muscle than is found in any recent reptile.

As the lower jaw of the *Iguanodon* does not contain more than 18 teeth in each ramus, it may be concluded that the portion of the upper jaw above described, supported at least one half of the dental series of the left side. The total length of that series in the skull to which such portion of jaw belonged must have been about 16 inches. The length of the alveolar tract, in the largest example of a ramus of the lower jaw yet discovered, Tab. XIII, fig. 1, is 13 inches.

In a cranium of the *Iguana tuberculata*, which measures $2\frac{1}{2}$ inches in length, the dental series occupies four sevenths of that length: according to the same proportions, therefore, the cranium of the *Iguanodon*, affording the above fragment of the upper jaw, would be 2 feet 4 inches in length. If the lower jaw of the *Iguanodon* exceeded the length of the cranium in the same proportion as in the *Iguana*, 2 feet 8 inches may be assigned to the total length of the skull of the *Iguanodon*, according to the evidences as yet obtained. But the unbiassed will feel that the rest of the structure of the *Iguanodon*, and especially of its teeth and vertebral column, differs in too great and important a degree from that of the *Iguana* to allow much confidence to be attached to the conclusions formed or suggested as to the *Iguanodon*, according to the osteology of the recent lizard, after which it has been called.

TEETH OF THE IGUANA. Tab. XVIII. (Figs. 1—5, after Mantell, 'Phil. Trans.')

Respecting these characteristic parts of the great extinct Reptile, little need be added to the observations recorded in my 'Odontography,' in the 'Monograph on the Fossil Reptilia of the Cretaceous Formations,' pp. 115—118, and the excellent descriptions by Drs. Mantell and Melville, in the 'Philosophical Transactions,' for 1848.

Fig. 1, is a fully formed and moderately worn tooth of the upper jaw, showing the outer side; *a*, is the submedian primary longitudinal ridge, *b*, *b*, the accessory ridges, *c*, *c*, the lamello-serrated margins of the crown, of which the anterior is the longest; *d*, *d*, the compressed subquadrate fang. Fig. 1 *a*, gives a view of the fore part of the same tooth, showing the varying proportions of the two diameters of the crown and fang. Fig. 1 *b*, gives the form of the grinding surface of the crown; *a*, is the primary ridge on the enamelled side; *b* and *c*, the two facets produced by the attrition of two opposed teeth on the lower jaw.

Fig. 2. The outer side of an old tooth from the left upper maxillary bone, of

which the crown is much worn down by the action of the opposite teeth below, and the fang much absorbed by the stimulus of the growth of a succeeding tooth. *a*, the primitive ridge; *b, b*, the accessory ridges; *c*, the angle of the anterior border. Fig. 2 *a*, the inner side of the same tooth, showing the cavity produced by absorption at the base *d*. Fig. 2 *b*, the grinding surface of the crown; *b, c*, the two facets produced by the attrition of two teeth of the lower jaw.

Fig. 3. The inner side of a successional tooth of the right ramus of the lower jaw, in which the crown is fully formed, with the beginning of the fang, but has not come into use, and shows the lamello-serrated margin entire; *a*, the primary ridge; *b, b*, the secondary ridges; *c*, the anterior border.

Fig. 3 *a*. The outer side of the same tooth, showing the widely open pulp-cavity, *p*.

Fig. 4, shows the outer side of a tooth from the left ramus of the lower jaw, the crown of which had recently come into use; *c*, the anterior margin of the base of the crown; *d*, the contracted end of the fang. Fig. 4 *a*, is an oblique view of the enamelled inner side and posterior angular border, *c*, of the same tooth.

Fig. 5, the outer side, fig. 5 *a*, the inner side, of a tooth from the left ramus of the lower jaw, in which all the serrated part of the crown has been worn down in mastication, and a great part of the fang renewed by absorption: the grinding surface shows the two facets *b* and *c*, produced by the action of the two opposing teeth of the upper jaw, and also the inequality due to the more rapid yielding of the softer unenamelled vaso-dentine, forming the outer half of the crown.

Fig. 6. The inner side of the germ of a tooth of the lower jaw of a young *Iguanodon*, probably from near the anterior end of the series. This tooth shows only the primary ridge, and the entire serrated margin of the crown.

Fig. 7. The outer side of a fully-formed and slightly worn tooth, from the upper jaw of a young *Iguanodon*.

Fig. 8. A magnified view of a longitudinal section of the upper part of the crown of a slightly worn tooth of an *Iguanodon*, illustrative of the microscopic structure described, pp. 116, 117, of the 'Monograph on Cretaceous Reptiles.' *e* is the thin layer of enamel which coats the outer side of the crown of the upper teeth and the inner side of that of the lower teeth; *d* is the hard or unvascular dentine, forming the corresponding half of the crown; *v* is the softer vaso-dentine, forming the inner half of the upper and the outer half of the lower teeth; *m*, the medullary or vascular canals; *c*, cement.

Fig. 9, is a transverse section of the outer part of an upper tooth, more highly magnified, of an *Iguanodon*, *d* the dentine, *e* the enamel. Fig. 9 *a*, a similar view of a transverse section from the inner half of the crown of the same tooth; *m*, the orifices of the medullary canals.

BONES OF THE EXTREMITIES OF THE IGUANODON.

These are remarkable for their superior development in proportion to the vertebræ of the trunk, as compared with the Iguana, the Crocodiles, and other existing Sauria. The scapular arch accords with the Lacertian type in being complicated with clavicles, and in the great breadth of the coracoid; but the scapula, in its length and simplicity, resembles more that of the Crocodiles than of the Lizards.

Scapula, Coracoid, and Humerus. Tab. XIV. One third the nat. size.

The scapula, Pl. XIV, figs. 1 and 2, is a long, flat, narrow bone, slightly bent backwards, gradually contracting in breadth and augmenting in thickness from its free extremity, answering to the base, *a*, to its articulated end, *d*, which suddenly expands and develops processes, *b*, *c*, before joining the coracoid, *f*.

These processes are two in number; one, *b*, is from the anterior border a little above the surface, *d*, for articulation with the coracoid; it is short and obtuse: the other, *c*, is still shorter, and comes off from the posterior border just above the articular surface, *e*, for the head of the humerus. The outer surface of the bone is slightly depressed between these processes, and becomes contracted beneath them where it forms the two articular surfaces, *d*, *e*, above mentioned.

The process, *b*, answers to the stronger and broader anterior process of the scapula of the Crocodile: the posterior process, *c*, seems to have no homologue in the modern Reptilia.

The scapula in the Amboina lizard, called *Istiurus*, sends backwards and upwards a process, but it is relatively longer than in the Iguanodon, and comes off higher up the scapula: the Psammosaurus and Grammatophora have no such process, and the entire scapula is much broader in proportion to its length. The scapula of the Iguanodon in general shape resembles that of the Crocodilia more than that of the Lacertian, but it is longer and more slender than in the Crocodile. The scapula, seen fractured across the femur in the Maidstone Iguanodon, see Tab. XXXIV, 'Monogr. Cretaceous Reptiles,' and figured in Dr. Mantell's Memoir, 'Phil. Trans.,' 1841, Pl. VIII, fig. 30, as an undetermined bone, repeats all the essential characters of the scapula so beautifully exposed, in natural connexion with the coracoid, in Mr. Holmes's specimen, figured in Tab. XIV, fig. 1.

The coracoid, fig. 2, *f*, more closely accords with the Lacertian type of that bone: it is a sub-semioval plate, broader than it is long, with the middle of its straighter border produced and thickened, and divided into two articular facets; one, fig. 1, *f*, for the scapula, the other, *g*, for the humerus: this articular part or "head" of the coracoid is marked off by a short constriction or "neck" from the broad plate or

the "head," widens as it sinks, its dilated termination answering to a foramen at that part of the coracoid in the Iguana, Istiurus, and Grammatophora: a smooth rounded notch divides the back part of the head from the backwardly produced obtuse angle of the bone, fig. 2, *g*. There is no process extended forwards from the fore part of the "body" of the bone: a notch, fig. 1, *h*, which penetrates the bone at the fore part of scapular end of the bone, as in the Lacertians above named; the lower and inner border of the expanded body of the coracoid describes a full semi-oval contour, which, in Mr. Holmes's specimen, fig. 2, is broken by a short and narrow notch, entering about the middle of that border.

In the comparative simplicity of the coracoid of the Iguanodon we may discern an affinity to the Crocodilian reptiles, and in its degree of expansion an affinity to the Lacertian order: this bone, as well as some other part of the skeleton, manifesting the intermediate position of the herbivorous Dinosaur, and its adherence to a more general type of Reptilian organization, than the modern forms of Reptile present.

An articular portion of the coracoid, measuring 10 inches in diameter, and discovered in the Wealden of Tilgate forest, is preserved in the British Museum.

The chief mark of difference from the Crocodilian structure of the scapular arch, and of resemblance to the Lacertian type, is the presence of a distinct pair of clavicles, the form of which is well shown in the instructive collection of parts of the same skeleton of the Iguana, discovered by Mr. Benstead, in his Green Sand quarry, near Maidstone. The only other bones to which the long and slender ones, marked "clavicle," in Tab. XXXIV, 'Mon. Cret. Reptiles,' can be compared, are the thoracic ribs and the fibulæ. The presence of the fibula in the same block of stone, and its discovery in close proximity with the tibia and femur in the Wealden strata, satisfactorily prove that the present remarkable bone cannot have formed part of the hinder extremity. And since, in most recent lizards, the radius, which is the more slender of the two bones of the fore-arm, differs from the fibula in little more than in being somewhat shorter and thicker, there is still less reason for supposing the bone in question to have belonged to the fore arm.

The form of the ribs of the *Iguanodon* is well known; their characteristic proximal extremity, in the longer anterior pairs of thoracic ribs, is shown in Tab. II, and they become shorter and more curved as they advance from the middle to the anterior part of the chest.

Amongst the bones obtained by Dr. Mantell from the quarry-men of Tilgate forest, and submitted by him, in 1830, to the examination of Baron Cuvier, was one, 28 inches in length, now in the British Museum, which the great founder of Palæontology thought "might be a clavicle:!"* portions of other homologous bones have been found, indi-

* This opinion is cited by Dr. Mantell in his 'Geology of the South-East of England,' 8vo, 1833 p. 308.

cating a total length of 3 feet. In a Memoir, communicated by Dr. Mantell to the Royal Society, and printed in the 'Philosophical Transactions' of 1841, the author dissents from the opinion of Cuvier; remarking, that, "In none of the skeletons of reptiles, or, indeed, any other animals to which he had access, are there any bones with which these fossils could be identified."* He regarded, therefore, the term clavicle as being manifestly inappropriate and liable to lead to misconception, and proposed to distinguish the bone in question by the term "*os Cuvieri*, as the Cuvierian element of the pectoral arch of the *Iguanodon*."† From a reference to myself, in the same page, it might be supposed that I had concurred in this view of the introduction of a new element in the scapular arch of the *Iguanodon*; but at the time when I assisted Dr. Mantell in the comparison of the bone in question, I was not aware that he entertained any such view of it as was afterwards expressed in the Royal Society's Transactions. "In a very small lizard in the Hunterian Museum, Mr. OWEN pointed out to me a bone attached to the coracoid and omoplate, that bore some analogy to the bone in question." The clavicle of the lizard alluded to (*Cyclodus nigroluteus*), bore sufficient resemblance, as I have before stated (Monogr. Cretac. Reptiles, p. 111), to the long and slender fossil under comparison, to confirm the conjecture of Cuvier; but it lent no support to the idea of the long and slender fossil in question being a peculiar superaddition to the Saurian skeleton. The bone is compressed, slender, and sub-trihedral at the middle part, expanded and flattened at the two extremities, bent with a slight double curve in a graceful sigmoid form. The broadest end, which, from the analogy of the *Cyclodus* lizard, must be regarded as the median or pectoral extremity, gives off two processes, the first appearing as a continuation of the thinner margin of the bone, twisted and produced obliquely downwards; the second process is given off nearer the expanded sternal end, towards which it slightly curves.

	<i>In.</i>	<i>Lin.</i>
The breadth of the expanded sternal end of a clavicle, 29 inches in length, is	3	7
The breadth of the scapular end	4	3
From this extremity to the base of the first process	19	0
The breadth of the narrowest part of the shaft	1	7

In the clavicles preserved in the Maidstone *Iguanodon*, the short pointed process is sent off at the angle where the shaft slightly bends as it expands into the sternal extremity; and the second process is a broad subquadrate flattened plate. In the *Cyclodus* lizard the clavicle is bent at an open angle, but nearer the middle of the shaft than in the *Iguanodon*; the known differences of form presented by the clavicles in the genera *Cyclodus*, *Istiurus*, *Grammatophora*, *Amblyrhynchus*, and *Iguana*, would have justified the expectation of some unexampled modifications of that variable bone in a great extinct Reptile belonging to a different order of the class.

* 'Phil. Trans.,' pt. ii, 1841, p. 138.

† Ibid.

The most interesting and instructive information regarding the humerus of the *Iguanodon*, afforded by Mr. Holmes's discovery, in 1847, of that bone, associated with the scapula and coracoid, in the same block of stone, was its relative dimensions to the scapula and other bones of the skeleton. The bones, so discovered, are represented, two thirds of their natural size, in Tab. XIV. Being shorter than the scapula of the same individual, and much shorter than the femur, the proportions of the humerus in the *Iguanodon* resemble more those of the extinct marine crocodile, called *Teleosaurus*, than those of any modern crocodile or lizard, and they indicate, as I have observed in a former Monograph, in connexion with the long, compressed, and vertically extended tail, the aquatic habits of this gigantic herbivorous reptile.

The head of the humerus, Tab. XIV, fig. 4, *a*, is somewhat prominent, and projects inwards and backwards at right angles to the shaft, between two sub-equal tuberosities. From the external of these tuberosities, *b*, a deltoid ridge is continued nearly half way down the bone, and gives the greatest breadth to the shaft a little above its middle part, at *c*. Where it subsides, the shaft is bent a little inwards, becomes more rounded, contracts in diameter, and then gradually expands to the distal condyles, *d, d*. These are rounded and moderately prominent; the shaft above them offers a broad and shallow concavity anteriorly, fig. 5, and a moderately deep longitudinal depression behind, fig. 3, which is continued into that between them shown at fig. 6. In the length of the deltoid ridge the humerus of the *Iguanodon* approaches nearer to the form of that bone in the Crocodile than in the Iguana; but it resembles more the humerus of the Iguana in the degree of concavity of the fore part of the shaft above the condyles.

The radius and ulna, well shown in the Maidstone *Iguanodon*, in the British Museum, and figured in Tabs. XXXIII and XXXIV, of the 'Monograph on Cretaceous Reptiles,' offer few differences worthy of notice, except their greater relative strength, from the corresponding bones in the Iguana. The olecranon of the ulna is more prominent and is rounded, as in the great monitor (*Varanus niloticus*).

PELVIS AND PELVIC OR HINDER EXTREMITIES.

The pelvis consists, as in recent reptiles, of the sacrum, with a pair of iliac, ischial, and pubic bones. The iliac bones, which would seem to become ankylosed to the sacrum in old individuals, have been already described, and are represented in Tabs. III, IV, and V of the present Monograph, and in Tabs. XXXIII and XXXIV of the 'Monograph on Cretaceous Reptiles.'

Pubis.—This bone, which presents a simple spatulate form in the Crocodile, already begins to increase in breadth at its symphyseal extremity in the extinct family with concave vertebræ; and in the larger existing species of lizards is expanded at both extremities, and has a very marked and recognisable character superadded, in being bent outwards with a considerable curvature.

A massive fragment of a broad osseous plate, bearing a segment of a large articular cavity at its thickest margin, and thence extended as a thinner plate, bent with a bold curvature, and terminated by a thick rounded labrum, offers characters of the Lacertian type of the pubis too obvious to be mistaken. This specimen, now in the British Museum, (No. $\frac{187}{2187}$, Mantellian Catalogue), is from the Tilgate strata; and since the modifications of the ilium of the Iguanodon in the Maidstone skeleton approximate to the Lacertian type of the bone, and especially as manifested by the great *Varani* in which the recurved character of the pubic plate is most strongly marked, we may, with much probability, assign the fossil in question to the pelvis of the Iguanodon.

This fine portion of pubis is of an inequilateral triangular form, 16 inches in its longest diameter, 9 inches 6 lines across its base or broadest part, 6 inches 8 lines across its narrowest part. The fractured surface of the bone, near the acetabulum, is 3 inches 3 lines thick. The acetabular depression is 7 inches across, a proportion which corresponds well with the size of the cavity in which the head of the Iguanodon's femur must have been received. One angle of the cavity, corresponding with the anterior one in the *Varanus*, is raised; a broad and low obtuse ridge bounds the rest of the free margin of the cavity. The smooth labrum exchanges its character near one of the fractured edges of the bone for a rough surface, which indicates the commencement of the symphysis. In the apparent absence of the perforation below the acetabular depression, the present bone agrees with the crocodilian type.

Ischium.—A second fragment of a large lamelliform bone, also in the British Museum, (No. $\frac{188}{2188}$, Mantellian Catalogue), presents, in its general form and slightly twisted character, most resemblance to the ischium, with traceable modifications intermediate to those presented by the extinct *Goniopholis* and the modern *Varani* and *Iguanæ*. The loss of the acetabular extremity, which is broken away, prevents a certain determination of this bone; the only natural dimension that can be taken is the circumference of the neck, or contracted portion between the acetabular end and the expanded symphysial plate: this circumference gives 7 inches. The slight twist of the bone upon this part as it expands to form the broad symphysial plate,—a character which is well marked in the ischium of the *Goniopholis*,—gives it a superficial resemblance to the humerus of some large Mammalia; but the bone is too short in proportion to the breadth indicated by the fractured symphysial end, to afford any probability of its having been a humerus of a land reptile, and much less of the Iguanodon, in which the form of the humerus is now well ascertained.

FEMUR OF THE IGUANODON. Tab. XV, figs. 1, 1a and 1b. One fourth the nat. size.

Several specimens of this remarkable bone,—the one that most impresses the observer with the magnitude of the extinct reptile to which it belonged,—are preserved in the British Museum. Of these the most entire and perfect specimen, the subject of the above plate

references, measures nearly 3 feet in length ; its circumference at the middle of the shaft is 18 inches ; the contour of the rounded inward-projecting part of head, *a*, is $17\frac{1}{2}$ inches ; two flat longitudinal facets meet near the middle of the anterior surface of the shaft at a rough and slightly elevated angle, *c*, which runs straight down to within thirteen inches of the distal end ; the ridge there inclines towards the internal condyle and subsides. Two strong muscles, answering apparently to the *vastus internus* and *vastus externus*, are indicated by the surfaces converging to this ridge. The head of the bone is carried inwards, overhanging the shaft. The line of the inner side of the shaft describes a graceful sinuous curve, being first concave, then slightly convex at the middle, where there is a peculiar process or ridge sometimes called the "third trochanter," *d*, but which does not answer to the part so called, and projecting from the outer side of the femur, in the Rhinoceros and some other mammalia. The part answering to the great trochanter, *b*, is characterised by its compression in the direction of the bone from *a* to *b*, and its great breadth in the opposite direction : it is flattened externally and is divided by a deep and narrow fissure from the neck of the femur. The line of the outer side of the shaft is slightly concave as it descends from the great trochanter, is then convex along the middle part of the shaft, and is again concave as it is continued into the somewhat expanded external condyle, *e*. This condyle is narrow in the direction from *e* to *f*, fig. 1, especially at its prominent fore part, which has been broken off in the specimen figured : it gradually expands towards its back part, and the femur of the Iguanodon is characterised by the depth, as compared with the breadth, of the rotular, (fig. 1*b*, *r'*) and popliteal, fig. 1*b*, *p*, channels or cavities which separate the outer condyle from the inner one *f*. The inner border of the femur below the process *d* gradually inclines and expands to a flattened antero-posteriorly extended, slightly concave surface, which then descends vertically to the articular surface of the condyle, which surface extends horizontally at nearly a right angle with the line of the shaft of the bone. The antero-posterior extent of the flattened inner condyle is 8 inches. The thickness of the compact external wall of the shaft varies from half an inch to an inch and a half. The medullary cavity, at its widest part, has an area of four inches by two inches in diameter. Both ends of this fine bone are somewhat crushed and mutilated.

The characters of the articular extremities of the femur which are obscured by the mutilated condition of the large specimen above described, are beautifully shown in the femur of a young Iguanodon, in the private collection of Mr. Holmes, obtained from a pit near Rusper, four miles north of Horsham. The rounded portion of the head extends inwards ; it is indented at its anterior part by the commencement of a longitudinal broad channel, which extends down upon the shaft ; the articular surface is not confined to the inwardly produced head, but extends over the whole proximal horizontal surface of the femur, expanding as it approaches the outer part of the head. The articular surface is circumscribed by a well-defined linear groove, which separates it from the longitudinal striated surface of the shaft of the bone. At the posterior and external angle of the articular

proximal end of the bone, a longitudinal column, the top of which may be compared to a trochanter, is separated by a deep and narrow vertical groove or fissure, from the main shaft of the bone, and falls into that shaft a little lower down: here the shaft expands and becomes rather flattened from before backwards, but is sub-quadrangular: a low ridge, produced by the union of two broad and flat surfaces, extends down the middle of the anterior surface of the shaft, and, inclining towards the inner condyle, gradually disappears. A little below the middle of the shaft the inner margin is produced into the angular ridge or low and long process, above described (*α*, fig. 1). The shaft of the bone has a large medullary cavity. The distal end is characterised by a deep and narrow anterior longitudinal groove, situated not quite in the middle, but nearer the external condyle; there is a corresponding deep longitudinal groove on the posterior part of the distal end, which is wider than the anterior one, and in the middle of the bone, separating the two condyles, but inclining beneath, and as it were undermining the backward projecting part of the internal condyle; this is much more prominent than the external one, which is traversed or divided by a narrow longitudinal fissure. The articular surface is irregular and tuberculate.

The following are some of the dimensions of this femur:

	<i>In.</i>	<i>Lin.</i>
The lateral diameter of proximal end	2	8
The lateral diameter of distal end	3	0
Antero-posterior diameter of outer part of proximal end	2	0
Antero-posterior diameter of outer part of internal condyle	2	3

In five separate long bones, in the Mantellian Collection, having the general characters of the two bones above described and of those of the Maidstone Iguanodon, which are marked "femur" in Tab. XXXIV, 'Monograph of Cretaceous Reptiles,' Nos. 1 and 3 differ from Nos. 4 and 5 in the greater inward production of the head, making the concavity of the line descending from the head to the median internal ridge somewhat deeper. The lower angle of this median ridge is more produced in Nos. 1, 2 and 3, than in Nos. 4 and 5. The whole inner contour is more regularly concave in No. 5 than in Nos. 1 or 3. Of these five bones, No. 2 was found associated with a tibia and fibula; and the differences above indicated illustrate the extent of the individual varieties of the same bone, so far as my opportunities of comparison have extended.

The femur of the Iguana differs as widely from that of the Iguanodon as does that of the Monitor or any other Lacertian reptile. The forms of the head and trochanter of the femur of the Iguana are just the reverse of those in the Iguanodon. The head of the femur in the Iguana is flattened from side to side, and its upper convex surface is extended from before backwards, making no projection over the gentle concave line leading from its inner surface down to the inner condyle. In the Iguanodon the head is rounded and rather compressed from before backwards, and is produced, as in Mammals, over the inner side of the shaft.

In the Iguana the trochanter is compressed from before backwards, and is separated by a wide and shallow groove from the oppositely compressed head; in the Iguanodon the trochanter is singularly flattened from side to side, and is applied to the outer side of the thick neck, from which it is separated by a deep and narrow fissure. The Iguana has no sub-median internal process, and its distal condyles are slightly divided by a shallow depression.

The circumference of the femur of the Iguanodon very nearly equals one half its length; the circumference of the femur of the Iguana only equals one fourth its length; yet the femur of the Iguanodon equals the united length of eleven of its dorsal vertebræ, while that of the Iguana equals the united length of only six of its dorsal vertebræ.

The femora of the Iguana stand out, like those of most other Lacertians, at right angles with the vertical plane of the trunk, which is rather slung upon than supported by those bones; but it is evident from the superior relative length and strength of those bones in the Iguanodon, from the different conformation of the articular, especially the proximal extremities, and from the ridges and processes indicative of the powerful muscles inserted into the bone, that it must have sustained the weight of the body in a manner more nearly resembling that in the pachydermal Mammalia. As in some of the more bulky of these quadrupeds, the indication of the "ligamentum teres" is wanting in the head of the femur of the Iguanodon.

TIBIA AND FIBULA OF THE IGUANODON. Tab. XV, figs. 2—7. One fourth the nat. size.

By the side of the femur, figured in Tab. XV, fig. 1, were found two other bones, the largest of which corresponds with the tibia in recent Crocodiles and Lizards. The homologous bone, better preserved, of a somewhat larger individual, is figured in Pl. XV, fig. 2. The external part of the head of this bone is produced horizontally, and its back part expands and divides into two condyles, *e*, *f*, fig. 2; the circumference of the proximal articular surface is 30 inches. The longitudinally finely striated vertical surface of the shaft of the tibia commences at the anterior part of the proximal end along a well defined curved line, which runs transversely across the bone, convex downwards in the middle, and concave downwards at each end: the bone gradually contracts, and assumes, about 8 inches below the head, the sub-quadrilateral form; it is broadest from side to side; its circumference is here 15 inches. The anterior surface is flattened; the outer side is convex or rounded; the dense external walls of this bone are very thick, at least 1 inch. The proximal articulation is convex from behind forwards, but, at the middle, it is slightly concave from side to side.

	<i>In. Lin.</i>
Its lateral diameter is	12 0
Its antero-posterior diameter is	13 6

The fibula nearly equals the length of the tibia ; the well-preserved specimen figured in Tab. XV., figs. 4—7, forms part of Mr. Holmes's choice collection of Wealden Remains from the vicinity of Horsham : it has belonged to a younger individual *Iguanodon* than the femur and tibia figured in the same plate.

The tibia of the *Iguanodon* equals the united length of nine of the dorsal vertebræ, while in the *Iguana* it does not exceed the united length of five dorsal vertebræ, although it more nearly equals the femur in length than in the *Iguanodon*. The head of the tibia is more expanded and more complicated by the condyloid prominences, and by their deep and wide groove in the *Iguanodon* than in the *Iguana*.

The disparity of strength between the tibia and fibula is considerable, but the difference in the thickness of the lower extremities of the two bones is less than the proportions of the shaft would indicate. On the middle of one of the flat sides of the fibula is an oblong rough surface slightly raised, measuring 3 inches by 2 inches. The articular extremities of the fibula are tuberculate, the lower and larger end is 5 inches across, the smaller one 3 inches across.

The fibula is more expanded towards the distal end and more flattened against the tibia in the *Iguanodon* than in the *Iguana*. It differs, also, from that of the *Iguana* in the well-marked, shallow, longitudinal concavity along the side of the lower half of the shaft which is next the tibia, as is shown in Tab. XV, fig. 4, (the views of the fibula in this plate have unfortunately been drawn on the stone upside down). The opposite side of the shaft is smooth and convex, as shown in fig. 3. In one diameter the fibula gradually contracts from the proximal to the distal end, as is shown in fig. 5 ; but in the opposite diameter it expands in a greater degree, and very suddenly, at the articular distal end. The form of the proximal surface is shown at fig. 7, that of the distal one at fig. 6.

The unusually perfect specimen, from which the figures 3-7 were taken, was obtained from the Wealden formation at the Tower-hill pit or quarry, near Horsham, by my esteemed friend G. B. Holmes, Esq., of that town, by whose accomplished daughter the original drawings of the bone were made. Another fibula of a small *Iguanodon* from a pit at Rusper, in the same gentleman's collection, equals the antero-posterior extent of the spines of eight dorsal vertebræ of the same individual. This bone is 13 inches long, 6 lines across the proximal end, and two inches across the distal end.

METATARSAL AND PHALANGEAL BONES OF THE IGUANODON. Tabs. XVI and XVII. Nat. size.

Of the great *Iguanodon* from the Horsham quarry, two metacarpal or metatarsal bones are preserved in natural juxtaposition, in Mr. Holmes's Museum : one exceeds the other by four inches in length, and measures 2 feet 6 inches : the breadth of its distal end is 3 inches 3 lines ; the shaft is compressed and subtriangular ; its texture is

spongy at the centre. The proximal end is expanded, with a nearly flat articular surface, the contour of which is broken by two longitudinal indentations; the distal end offers a well-sculptured trochlear articulation for the first phalanx. The bone of the Maidstone Iguanodon (marked 'metatarsal' in the plate above cited) corresponds with the shorter of the two bones above cited.

Some of the phalanges, probably the middle ones, appear to have been singularly abbreviated; but they have not yet been discovered in such juxtaposition with undoubted Iguanodon's bones as to justify a more precise description of their characters under the present head.

Of the uppermost or proximal phalanges, one tolerably perfect specimen has long been known to palæontologists. It probably belonged to the left fore-foot of the Iguanodon, and is from the Wealden iron-sand which forms the shore of the Isle of Wight, east of Sandown Fort. This specimen, Tab. XVI, fig. 1, is described by Dr. Buckland as a 'metacarpal bone' in the 'Geological Transactions,' vol. iii, 2d series, p. 425: it does not exhibit, however, any articular facet at the side of the proximal end for junction with a contiguous metacarpal; and at the distal end, instead of a uniform convexity, it presents the trochlear combination of a vertical convexity with a transverse concavity. The inference, therefore, as to the metacarpal bones of the Iguanodon being much shorter and thicker than in any living crocodiles or lizards, receives no support from the proportions of the present specimen.

The following is the notice of the original specimen, in the memoir above quoted.

"The first of these two new localities" (for fossil remains of the Iguanodon) "is on the south coast of the Isle of Wight, in the iron-sand which forms the shore, a little east of Sandown Fort, between high and low water. The most remarkable specimen I possess from thence is the gigantic metacarpal bone about to be described. The form of this bone nearly resembles one in the collection of Mr. Mantell, which Cuvier saw, and pronounced to be a metacarpal bone of the thumb of a reptile; but much exceeds it in size, measuring 6 inches in length, 5 inches in width at its largest diameter, and 16 inches in circumference at its posterior and largest extremity. Its weight is nearly six pounds.

"It is, I believe, the largest metacarpal bone which has been as yet discovered; and if we apply to the extinct animal from which it was derived, the scale by which the ancients measured Hercules (*"ex pede Herculem"*), we must conclude that the individual of whose body it formed a part, was the most gigantic of all quadrupeds that have ever trod upon the surface of our planet. The corresponding bone in the foot of the largest elephant is less than our fossil metacarpal by more than one half. The bone represented by Mr. Mantell (Pl. 14, figs. 4, 5, of his 'Fossils of Tilgate Forest') approaches the nearest of all those engraved by him in this work, to our bone from Sandown Bay. He considers his fossil to be most probably a metatarsal bone of the Iguanodon, and states that he has one such bone which measures $4\frac{1}{2}$ inches in

length, and 13 inches in circumference at the largest tarsal extremity. The colossal proportions of a fragment of a femur in his possession, from Tilgate Forest (Pl. 18, fig. 1 of the same work), which measures 23 inches in circumference in the smallest part, sufficiently accord with those of his metatarsal bone last mentioned, as well as our metacarpal bone from the same formation in the Isle of Wight, and give strong probability to the opinion that all these three fragments of the skeleton of a reptile of such extraordinary stature may be referred to the Iguanodon. It is obvious that these supposed metacarpal and metatarsal bones are much shorter and thicker in their proportions than the metacarpal or metatarsal bones of any living lizards or crocodiles; but when we consider the enormous weight which the foot of an animal whose femur was 23 inches in circumference must have sustained, a reduction of length and increase of bulk in the bones which supported such a colossal frame, must have been attended with many mechanical advantages."

The distal or ungual phalanges of the Iguanodon, although doubtless offering certain modifications of form in different toes, are shown by those preserved in the Maidstone Iguanodon, and by others of much larger dimensions found associated with the bones of the great Iguanodon of the Horsham quarry, to have had a less incurved, broader, and more depressed form than in other known saurians. Two of the largest ungual phalanges of the Horsham Iguanodon in Mr. Holmes's collection, are broad, subdepressed, and exhibit, as in most other saurians, the curved vascular groove on each side: they have an articular, slightly concave base, and terminate anteriorly in a round blunt edge; the outer boundary of the lateral grooves form at the posterior end of the groove, a laterally projecting process, making this part of the phalanx broader than the articular extremity or basis. The following are dimensions of the largest of the two phalanges:

	<i>In.</i>	<i>Lines.</i>
Length	5	4
Breadth	3	2
Breadth at articular end	3	0
Depth	2	3

at the posterior end it gradually diminishes to the distal end.

The phalanx is slightly bent downwards; the under surface being concave longitudinally, but convex from side to side. The under surface is rough, the upper surface nearly smooth, except at the margin of the articular surface, on the projecting sides and at the distal extremity, which is sculptured by irregular vascular grooves and holes. The phalanx has a slight oblique twist to one side, and is somewhat thinned off to that side on which the curved groove is longer than on the other side.

In Mr. Saull's museum is an ungual phalanx of an Iguanodon, which nearly equals those from Horsham, and presents the same subdepressed form. The base is slightly convex transversely, more concave vertically; the articular surface is

faintly divided by a median vertical rising; the rounded edge of the articular surface is slightly raised, and is interrupted on both sides by smooth shallow commencement of the curved vascular groove; this deepens and contracts as it extends forwards. The upper surface of the phalanx is convex longitudinally and transversely; the lower surface is rather more convex transversely than the upper, but is slightly concave longitudinally. The upper and lateral surfaces, for about an inch near the base, are deeply sculptured by large irregular longitudinal grooves and ridges; the rest of the upper surface is impressed by fine interrupted longitudinal impressions, but having, on the whole, a smooth appearance. The laminated superposition of the exterior compact portion of the bone is shown by the separation of portions of the layers of about one line in thickness. The under surface is more deeply impressed by cavities having reticulate elevations. The right aliform process begins 10 lines from the articular surface, the left about 14 lines from the same part; this base is bounded below by slight impressions, and above by the lateral canals, which appear to sink into the bone. A few distant vascular grooves mark the upper surface of the bone, but more numerous larger ones are situated near the lateral canals and at the broken anterior end of the phalanx. The following are its dimensions:

	<i>In. Lines.</i>	
Transverse diameter of bone	3	5
Transverse diameter of broken end	2	2
Vertical diameter of base	2	7
Vertical diameter of broken end	1	6
Length to broken end	4	4

The largest phalanx of this kind which has hitherto come under my observation is one (Tab. XVI, fig. 2) which had been washed out of the same tidally submerged Wealden iron-sandstone, which forms the shore between high and low water to the east of Sandown Fort, Isle of Wight. This phalanx had been rolled and waterworn, like most of the saurian fossils from that locality. The margins of the articular base of the phalanx are thus rounded off, and those of the sides and extremity have been worn away, rendering the latter more obtuse. Nevertheless, in this state, the phalanx measures 6 inches in length and $4\frac{1}{4}$ inches in breadth, much surpassing in size the largest ungual phalanx of the elephant, mammoth, or mastodon. It would be unsafe, however, to infer from the size of a claw or the bone supporting it that of the entire animal; an ungual phalanx presents very different proportions to the rest of the limb and to the entire animal, in different species: that of a horse, *e.g.*, exceeds in size that of an elephant: and the ungual phalanx of a sloth is longer than that of the largest crocodile. In the general proportions, and broad subdepressed form of the bone here described, it resembles the more perfectly preserved ungual phalanges known by their association with other parts of the skeleton to have

belonged to the Iguanodon. The outer boundary of each lateral vascular groove expands to form similar aliform projections, as at *b*, fig. 2; the grooves terminate rather abruptly, but do not penetrate the substance of the bone. The upper surface, between the lateral grooves, is convex and smooth; the under surface, shown in the figure, is rough, and impressed by irregular vascular grooves and foramina. In its size and proportions this phalanx agrees with the proximal one figured in the same plate, Tab. XVI, fig. 1; it may have belonged to the same individual, and certainly came from an Iguanodon of the same colossal proportions.

Among the few other phalangeal bones from Dr. Mantell's collection in the British Museum, there is one (figured in the 'Wonders of Geology,' pl. iii, fig. 1, as belonging to the fore-foot of the Iguanodon) which differs in a marked manner from the specimens just described, being as much compressed from side to side as some of the unquestionably Iguanodon's ungual phalanges are flattened from above downwards. One of these compressed phalanges must have been at least 4 inches in length; it now measures 3 inches, with the extremity broken off; it is 2 inches 8 lines in vertical diameter at the base, and only 1 inch 2 lines in the greatest transverse diameter. The phalanx is more curved downwards than any of the true Iguanodon's phalanges, and is traversed by a longer and shallower groove, the lower margin of which is not produced into a lateral aliform process, nor does the distal end of the groove sink into the substance of the bone. The ungual phalanges on both the fore and hind feet of the Iguana resemble this phalanx in form more than they do those of the Iguanodon. In the fore-foot of the crocodile the ungual phalanx of the first or innermost toe is broad and flat, with lateral ridges, much resembling the depressed phalanges of the Iguanodon. The ungual phalanx of the third digit is of the same length, but is thinner in both transverse and vertical directions, though less so in the latter; it is not more curved. Still the difference, and this is the greatest that I can perceive in comparing the different ungual phalanges of the same individual crocodile (*Croc. acutus*), is much less than that which is manifested between the depressed and the compressed phalanges hitherto referred to the Iguanodon. It is highly probable that the terminal phalanges of the different toes of the Iguanodon were somewhat varied in form; but the compressed incurved phalanx supposed to characterise the fore-foot of that great herbivorous reptile, appears to me to present rather the form of the phalanx of a great carnivorous Saurian. In the great proportion of the skeleton found near Maidstone are two phalanges which correspond in form with those enormous specimens found near Horsham, and on the south coast of the Isle of Wight, and with the small depressed claw-bones from Tilgate Forest, unquestionably belonging to the Iguanodon, and supposed by Dr. Mantell to be peculiar to the hind foot of that Saurian.

Amongst the varieties of large fossil ungual phalanges discovered in the Wealden of Kent, Sussex, and the Isle of Wight, I should be more disposed to refer to a

herbivorous Saurian that modification which is less incurved than the typical form in the Iguanodon, and which exhibits that straighter and more conical form of phalanx, Tab. XVII, figs. 1, 2, 3, (No. ³⁸⁴/₂₃₈₄ "Horn of the Iguanodon" Mantellian Collection and Catalogue) described in p. 141 of my 'Report on British Fossil Reptiles,'* and the determination of which, as a phalanx, in that 'Report,' subsequent acquisitions of similarly modified phalanges, *e. g.*, figs. 4, 5, Tab. XVII, have served to confirm.

As, however, the original opinion of the indefatigable explorer of the Wealden, to whom we owe our chief knowledge of that formation in England, has continued to prevail in the numerous geological and palæontological works published since 1841, it is incumbent on me to enter more into detail relative to the fossil on the nature of which I found myself compelled to differ with its original discoverer.

A certain resemblance in outward form, which the fossil teeth of the Iguanodon present to those of the Iguana, has exercised, as I have already intimated, undue influence in the prevalent ideas as to the affinities of the gigantic herbivorous reptile of the Wealden to the small existing lizard, after which it has been named. The Iguanodon, indeed, is generally supposed to have been characterised by a singular structure, viz., a horn, like that which, in the existing order of Saurians, distinguishes one of the species of Iguana, (*Metopoceros*, or *Iguana cornuta*).

The following observations on the fossil which has given rise to that opinion, may tend in some degree to modify, and I believe to rectify the received ideas as to the nature and affinities of the Iguanodon.

The bone to which I allude is that which Dr. Mantell has described as the "horn of the Iguanodon" in the following words, which convey an accurate idea of its general form and size.

"We have," says Dr. Mantell, "to request the reader's attention to a very remarkable appendage with which there is every reason to believe the Iguanodon was provided. This is no less than a *horn*, equal in size, and not very different in form, to the upper horn of the rhinoceros. This unique relic is represented of the natural size, Pl. XX, fig. 8.† It is externally of a dark brown colour, and while some parts of its surface are smooth others are rugous and furrowed, as if by the passage of blood-vessels. Its base is of an irregular form, and slightly concave. It possesses an osseous structure, and appears to have no internal cavity. It is evident that it was not united to the skull by a bony union, as are the horns of the mammalia."

The only reason which I have, hitherto, been able to find adduced for the above determination of the fossil described as "the horn of the Iguanodon," is, that a species of Iguana has, on the middle of its forehead, an osseous conical horn or process covered by a single scale."‡

* 'Reports of the British Association,' 1841.

† 'Illustrations of the Geology of Sussex,' 4to, 1827, p. 78, pl. xx, fig. 8.

‡ Loc. cit., cited from 'Shaw's Zoology.'

The first and most obvious objection to the fossil in question, (No. ³⁸⁴₂₃₈₄, Mantellian Collection, British Museum), being the bony core of a median frontal horn, is its *want of symmetry*. This is plainly manifest in two respects; first, by the obliquity of the base; and secondly, hold it as you may, by the inequality and difference of form of the two sides. If the fossil be viewed with the apex upwards and forwards, as in the position in which Mr. Dinkel has delineated it, Tab. XVII, fig. 1, when I desired him to draw it in the position in which it appeared least unsymmetrical, even then the left side is, by reason of the basal obliquity, longer than the right, and it is more convex in the vertical direction. This view exposes what I believe to be the left side of the phalanx.

With respect to the base of the bone, all its natural surface, with the exception of one small spot, has been chiselled or scraped away, and the central coarse cellular structure of the bone is thus exposed. That single smooth spot, however, indicates that the base had been articulated by a synovial joint, and the form of the rest of the mutilated basal surface nowise militates against the supposition of the conical bone having been the *terminal unsymmetrical unguis phalanx* of the outer toe of a great Saurian reptile.

The want of symmetry in the unguis phalanges of the outer and inner digits of a reptile's foot, in which phalanges one side becomes longer and more convex than the other, exemplifies the nature of that degree of want of symmetry which exists in the fossil in question, and which ought of itself to be decisive against the opinion of such fossil being the basis of a single median frontal horn.

Yet this idea has been so long fixed and so generally received, that, although the objection above advanced may unsettle it, yet additional reasons may be expected before it will be finally abandoned. For, to the objection of mere want of symmetry, it may be replied, that this particular example of the horn of the Iguanodon may exhibit an accidental deviation from the normal structure; although, indeed, an unsymmetrical horn has never been noticed in the horned Iguana (*Metopoceros*). Yet even at this stage of the argument it will not be hard to decide between a *phalanx* to which the unsymmetrical form presented by the fossil is natural, and a *horn* in which such dissymmetry would be monstrous. Independently, however, of general configuration there are other characters by which an unequal phalanx of a crocodilian or other large Saurian may be detected.

An unguis phalanx is a significant bone; it has relations which no other phalangeal or other bone of a foot possesses, and has modifications of surface, of form, and structure subservient to those relations.

First, it supports the strong horny sheath or claw which immediately presses upon the ground, and which accordingly needs constant and copious reparation. An unguis phalanx, therefore, besides its own "periosteum" is invested by a highly vascular and almost glandular "corium," which is the active renovator of the worn-down claw.

All ungual phalanges of Saurian reptiles are marked on each side by a large, more or less deep and smooth groove, curved with the convexity towards the upper side of the claw. These grooves convey the blood-vessels and nerves to the matrix of the claw, and, in some species, sink at their distal end into the substance of the claw-bone.

But, it may be said, the bony basis or core of a frontal horn likewise supports a corneous sheath, and is invested by the vascular cutis which secretes that sheath. Since, however, the corneous sheath of a horn, and especially of so small a one as that which arms the head of the *Iguana cornuta*, and, as has been imagined, also of the Iguanodon, is less constantly and rapidly abraded than a claw, so the indications of the vascularity and activity of the reproductive organ are much more feebly marked upon the horn-core than upon the phalanx. They are also marked in a different manner. The horn-core is incased by its horny sheath, its base alone being free from that covering. The renovation of the horn takes place, as is well known, chiefly at the base, and the numerous vascular impressions are distributed pretty equally round the base of the core.

In the Saurian claw-bone the upper surface and sides are invested by the claw, and the renovation of the corneous matter is required near the sides of the distal half of the osseous cone. Hence in the phalanges of the large Saurian we see the large vascular curved groove extending along each side, and the canals by which the vessels and nerves emerged from the bone upon its immediately investing vascular organ of the claw are most conspicuous on each side near the apex.

Now the fossil in question exhibits conspicuously the two lateral, curved, wide and deep vascular grooves, *c*, *c'*, *d*, *d'*, figs. 1 and 2, and each groove sinks at its distal end, *c*, *d'*, into the substance of the bone; the large oblique foramina, *e*, by which the blood-vessels and nerves emerged to supply the secreting organ of the claw are also present in greatest number on each side of the apex of the bone: these characters I hold to be decisive of the phalangeal nature of the so-called horn.

The groove on the right side of the phalanx, (fig. 2, *c*) as seen in a view of its upper surface, which is determined by the convexity of the vascular grooves, is entire: it begins about two thirds of an inch from the base, is shallow at first, but gradually becomes deeper, until it sinks into the substance of the bone. (at *c'*): it presents the usual gentle and regular curve, convex upwards; its length, following the curve, is $1\frac{1}{2}$ inch; it sinks into the osseous substance nearly two inches from the broken apex of the phalanx; its breadth is between 2 and 3 lines.

On the left side, fig. 1, a portion of the vascular groove, *d*, *d'*, is obliterated by the loss of part of the compact outer layer of the upper surface of the phalanx, forming the median edge of the groove, but the lateral or outer, and the terminal half inch of the groove where it sinks into the substance of the bone, as at *d'*, figs. 1 and 2, is entire: enough remains, therefore, to show that the groove on the left side of the phalanx had

the same degree and direction of curvature as that on the right side; but the left groove becomes shallower and wider towards its beginning, which may be traced as far back as the base of the phalanx, as in Mr. Saull's specimen. The vascular foramina, at and beyond the opposite termination of the left groove, are not less numerous and conspicuous than are those on the right side; but the left groove is somewhat in advance of the right, and sinks into the unsymmetrical phalanx one inch and four lines from the broken apex. At one fourth of an inch below the left vascular groove there is a shallow, smooth impression, *f*, fig. 1, along the distal half of the bone, indicating the extent to which the lateral margin of the claw reached on that side: there is no corresponding impression on the opposite side, which coincides with the dissymmetry of the phalanx, in showing it to have belonged either to an outermost toe of the left foot, or to an innermost toe of the right foot.

The exterior of the bone around its base is sculptured, as in other and normally shaped phalanges, by smaller but coarse longitudinal impressions, corresponding with the attachments and insertions of the articular capsule and ligaments. The part of the bone, proved by the direction of the large smooth lateral grooves to be the under side, is the shortest, and is most convex transversely. The upper side is the longest, and is narrower across than the under side.

	<i>In.</i>	<i>Lines.</i>	
The length of this phalanx is	4	6	(doubtless 5 in. when entire.)
The longest diameter of its base is	3	3	
The shortest diameter of its base is	2	2	
The distance between the distal terminations of the lateral grooves	1	0*	

What might be the chances, it may be asked, that the single small bone supporting the median frontal horn should be found fossil, on the hypothesis that the *Iguanodon* possessed, like the *Iguana cornuta*, such a dermal appendage? Supposing an extreme toe, outermost, or innermost, of the fore and hind feet of the great reptile to have had a claw shorter and straighter than the rest, it would be four to one that the bone of such claw should be found, than the unique bone of the horn. By great good luck, indeed, the latter might once turn up; but one could not expect the only bone of its kind, and one of the smallest in the skeleton of the *Iguanodon*, to be frequently found. Yet I have had not less than three "horns of the *Iguanodon*" submitted to my inspection since describing the one so called in the British Museum. And two of these supplemental examples of straight conical claw-phalanges are figured in Tab. XVII. The first, figs. 3 and 4, was discovered in the Wealden of the Isle of

* The two figures in Tab. XVII have been made with the most scrupulous accuracy from the original fossil now in the British Museum, and exhibit characters not before given in any published figure of the so-called "horn of the *Iguanodon*."

Wight, and is in the collection of Felix Knyvett, Esq., by whose kind permission it is here described and figured. It has an irregular, slightly concave base, broader than it is high, and has a well-marked deep vascular groove on each side: that to the left, *d'*, sinks into the substance of the bone as it approaches the apex, where it communicates with several large vascular foramina: the right groove, *c*, resembles that in fig. 2, in being shorter and more curved; but it seems to have given off its branches to the claw-forming matrix before sinking into the substance of the bone: the upper surface between these grooves is narrower and less convex than the under one, in which respect this phalanx also resembles figs. 1 and 2. Fig. 3 gives a side view, the left, of the second example of straight conical phalanx, showing the narrowest transverse diameter of the bone, as in fig. 1. Fig. 5 is a smaller phalanx of the same unsymmetrical, conical form, with an irregular slightly concave basal articulation, and with impressions of the two lateral vascular grooves; that on the left side, *d'*, being the best marked, and sinking into the substance of the bone, as in the other specimens figured. It is from the Wealden of Battle, Sussex; and is also in the collection of Felix Knyvett, Esq.

Having thus, as I believe, determined the true nature of the supposed horn of the *Iguanodon*, and lowered the problematical fossil from its place on the forehead to the end of one of the toes of some great Wealden Saurian, it remains to inquire to which of the gigantic reptiles of that formation the present phalanx may be, with most probability, referred.

There are three forms of fossil phalanges from the Wealden strata. One is broad, depressed, subsymmetrical, rounded at the apex, with the outer boundary of each lateral vascular groove produced like two aliform ridges, and the grooves commonly terminating without sinking into the bone.

This form of phalanx Dr. Mantell refers to the hind foot of the *Iguanodon*: and that it belongs to the *Iguanodon* is shown by the instructive series of bones of the same individual, rescued by Mr. Bensted from the Green Sand quarry at Maidstone.

Another form of phalanx is the reverse of the above, being compressed, curved downwards, with the lateral grooves longer and shallower, and their lower or outer boundary is not produced into an aliform process. This form is figured in the 'Wonders of Geology,' pl. iii, fig. 1, as belonging to the fore foot of the *Iguanodon*.

The ungual phalanges on both the fore and hind feet of the *Iguana* resemble this second form more than they do the first; but by no means differ from each other, as those of the *Iguanodon* must have done on Dr. Mantell's hypothesis.

In the fore foot of the Crocodile the ungual phalanx of the first toe is broad and depressed, with lateral ridges, and more resembles the phalanx in the Maidstone *Iguanodon*: the ungual phalanx of the third digit of the Crocodile is of the same length as the first, but is thinner in both transverse and vertical directions, though least in

the latter: it is not more curved than the first. Still the difference, which is the greatest I can detect in comparing the different ungual phalanges of the same Crocodile, is much less than that which is manifested by the depressed and compressed phalanges hitherto deemed to characterise the hind and fore feet of the Iguanodon. I think it more probable, therefore, that the second form of Wealden phalanx appertains to a distinct species from the Iguanodon, and probably to a carnivorous Saurian.

The third form is that which, less depressed than the first and less curved than the second, has been described as *the horn* of the Iguanodon. The outer border of the lateral vascular grooves are very slightly produced, and the grooves themselves commonly sink into the substance of the bone, as they do in the great phalanges of the Cetiosaurus. Some of these straight conical phalanges, *e.g.*, those figured in Tab. XVII, figs. 1, 2, 3, and 4, seem to be too large for the *Hylæosaurus*.

But I shall refrain, at present, from indulging in conjecture, however probable, as to the species of reptile to which this third form of phalanx belongs, satisfied with the present evidence of the nature of the bone itself, and that, if it ever formed part of the skeleton of the Iguanodon, it belonged to the foot and not to the head: and I shall conclude by briefly summing up the characters which ought to be borne in mind when the idea of the little modern Iguana is associated, through similarity of sound, with that of the great Iguanodon.

Both articular ends of the vertebræ of the Iguanodon are nearly flat, thereby differing more from the concavo-convex vertebræ of the Iguana than those of any existing Crocodile or Lizard do.

The anterior ribs of the Iguanodon have a head, neck, and tubercle, and a double articulation with the cervical and dorsal vertebræ; those of the Iguana and of every other existing Lizard have no cervix or tubercle, and have only a single articulation with the cervical and dorsal vertebræ. In this important modification of the anterior ribs the Crocodile has a greater resemblance and closer affinity to the Iguanodon than the Iguana has.

The height, breadth, and outward sculpturing of the neural arch of the dorsal vertebræ of the Iguanodon, are characters wanting in the Iguana and all modern Lizards, but are remotely approximated to in the dorsal vertebræ of the Crocodile, which, however, are far from presenting the expansion and complexity of the dorsal neural arches in the Iguanodon.

Five vertebræ of unusual construction are anchylosed together to form the extended sacrum of the Iguanodon: in the Iguana the small and simple sacrum consists of only two slightly modified vertebræ; in this respect it more closely resembles other Lizards, and even the Crocodiles, than it does the Iguanodon.

For the important difference in the structure of the teeth of the Iguanodon and Iguana, I refer to my former Monograph ('Cretaceous Reptiles,' pp. 115—117), and to p. 30 of the present Monograph.

INTEGUMENT (?) OF THE IGUANODON. Tab. XV, fig. 8.

In that part of the specimen of the skeleton of the young Iguanodon, figured in Tab. I, which is in the Museum of Mr. Bowerbank, some portions of a layer of dark, finely granulated carbonaceous matter, were found imbedded between the ribs, near the middle of the side of the trunk, and slightly adhering to the discoloured matrix: this layer is very probably, as Mr. Bowerbank believes, a part of the integument of the Iguanodon. Of the best preserved portions of this substance, the largest is an oblong one, 8 lines in long diameter; another is 6 lines in diameter; and both are about 1 line in thickness. Supposing the Iguanodon to have been covered by epidermal scales like those of the Iguana, and of proportional size, a single scale would cover from four to six times the extent of corium which is shown by the largest of the above specimens, on the supposition that they are parts of the true skin of the Iguanodon.

The firmer and more enduring parts of the substance here displayed seem to have consisted of coarse fibres, irregularly interlacing each other; these form the darker parts which rise above the surface and give it, when viewed by the naked eye, a subgranular character; the depressions indicate the interspaces of the fibres, and contain fine particles of a substance of a lighter colour. I have not been able to detect any clear traces of ultimate organic structure in the black carbonized remains of the fibrous tissue.

So much of structure as is discernible accords well with that of the corium of a tough and thick skin; but no conclusions can be satisfactorily deduced from the small portions here preserved, as to the nature of the defensive covering, epidermal or osseous, of the corium of the Iguanodon. The experienced microscopist to whom I am indebted for the opportunity of inspecting these rare and interesting specimens, writes to me: "I have examined the skin with the greatest care with my microscope, but I cannot find any indications of scales." My own observations have led to the same result. The visible character, however, of the surface of the supposed fossil skin of the Iguanodon, is not inconsistent with that of the vascular corium of a reptile which nourishes an overlying epidermal scale, or osseous plate or scute, either of which parts, if present in the living animal, would be most probably much larger than the largest of the fragments that have been here preserved. The chief difference between the corium of a squamate and that of a loricatè reptile, is its less thickness in the latter where it underlies bone, than where it supports a scale, as in the squamate species.

Allowing for the extreme shrinking and condensation of skin which has become carbonized in the present rare instance, and has resisted the common result of the dissolving agencies, I should infer from these fragments that they might have originally been of that thickness which is consistent with an external covering of epidermal material.

Considering the great numbers of teeth and bones of the Iguanodon that have been collected from different localities during the last thirty years, and the collocation of some of these remains so as to prove that the entire carcase of an Iguanodon had been imbedded in the matrix, as in the case of Mr. Bensted's discovery near Maidstone, fossil bony scutes, had they existed in any quantity in the skin of the Iguanodon, might reasonably be expected to have been found associated with the parts of the endoskeleton. Such dermal bones have been discovered in connection with other remains of the *Hylæosaurus*, and we may, therefore, with more confidence assign its value to the negative evidence in the case of the Iguanodon, and conclude that the surface of its nuge body was defended by thickened epidermis, either coextensive with the chorion, or specially developed and multiplied in the form of scales.

SIZE OF THE IGUANODON.

From the comparison, which the few connected portions of the skeleton of the Iguanodon enable us to make, between the bones of the extremities and the vertebral column, it is evident that the hind legs at least, and probably also the fore legs, were longer and stronger in proportion to the trunk than in any existing Saurian. One can scarcely suppress a feeling of surprise that this striking characteristic of the Iguanodon, in common with other Dinosauria, should have been so long overlooked; since the required evidence, as pointed out in my 'Report on British Fossil Reptiles,'* is only an associated vertebra and long bone of the same individual, or a comparison of the largest detached vertebræ with the longest femora or humeri. This characteristic is, nevertheless, one of the most important towards a restoration of the extinct reptile, since an approximation to a true conception of the size of the entire animal could only be made after the general proportions of the body to the extremities had been ascertained.

It was obvious that the exaggerated resemblances of the Iguanodon to the Iguana misled the Palæontologists who had previously published the results of their calculations of the size of the Iguanodon;† and, hence, the dimensions of 100 feet in length arrived at by a comparison of the teeth and clavicle of the Iguanodon with the Iguana, of 75 feet from a similar comparison of their femora, and of 80 feet from that of the claw-bone; which, if founded upon the largest specimen from Horsham, instead of the one compared by Dr. Mantell, would yield a result of upwards of 200 feet for the total length of the Iguanodon, since the Horsham phalanx exceeds the size of the largest of the recent Iguana's phalanges by 40 times!

But the same reasons which I have assigned for calculating the bulk of the *Megalosaurus* on the basis of the vertebræ,‡ apply with equal force to the Iguanodon.

* Reports of the Brit. Association, 1841, p. 142.

† Mantell, 'Geology of the South-east of England,' p. 314. Buckland 'Bridgewater Treatise,' p. 243.

‡ Reports of the Brit. Association, 1841, p. 109.

Now the largest vertebra of an Iguanodon which has yet been obtained does not, as has been before stated, exceed $4\frac{1}{2}$ inches in length; the most common size being 4 inches. The intervertebral substance is shown, by the naturally juxtaposed series of dorsal vertebræ in the Maidstone Iguanodon, to be not more than one third of an inch in thickness. All the accurately determined vertebræ of the Iguanodon manifest the same constancy of their antero-posterior diameter which prevails in Saurians generally; the discovery of the true character of the supposed Lacertian vertebræ, six inches in length, removes the only remaining doubt that could have attached itself to this important element in the present calculation.* The anterior cervical vertebræ of the Iguanodon, when discovered, if they prove to differ in length from the known dorsal and caudal vertebræ, will be, in all probability, somewhat shorter, as they are in the *Hylæosaur* and in all known Crocodiles and Lizards. It remains, therefore, to determine the most probable number of the vertebræ of the Iguanodon, in order to apply their length individually to the estimate of the length of the entire body. The structure of the vertebræ and the ribs, and especially the variation in both structure and size which the ribs of the Iguanodon, already obtained, demonstrate to have prevailed in the costal series, render it much more probable that the number of the costal vertebræ would resemble that of the Crocodiles than that of the *Scincus* or other Lizards with unusually numerous dorsal vertebræ, and which possess ribs of a simple and uniform structure, and of nearly equal size. The most probable number of vertebræ of the trunk, from the atlas to the last lumbar inclusive, calculated from Crocodilian analogies, would be 24 vertebræ. This is the number indicated by the instructive portion of the skeleton of the young Iguanodon figured in Tab. I, and for the first time described in the present Monograph: it is also the number possessed by the Iguana.

Twenty-four vertebræ, estimated with their intervertebral spaces at 5 inches each, give 10 feet; if to this we add the length of the sacrum, viz., 17 inches, then that of the trunk of the Iguanodon would be 11 feet 5 inches; which is about equal to that of the *Megatherium*. If there be any part of the skeleton of the Iguana which may with greater probability than the rest be supposed to have the proportions of the corresponding part of the Iguanodon, it is the lower jaw, by virtue of the analogy of the teeth and the substances they are adapted to prepare for digestion. Now the lower jaw gives the length of the head in the Iguana, and this equals the length of six dorsal vertebræ, so that as 5 inches rather exceeds the length of the largest Iguanodon's vertebra yet obtained, with the intervertebral space superadded, on this calculation the length of the head of the largest Iguanodon must have been about 2 feet 6 inches, and this is nearly the length of the head, as estimated on the data afforded by the portions of lower jaw described at pp. 20—30. In the description of the caudal vertebræ it has been shown that the Iguanodon could as little have

* Reports of Brit. Association, 1841, p. 92.

resembled the Iguana in the length of its tail,* as in the anatomical characters of any of the constituent vertebræ of that part: the changes which the series of six caudal vertebræ present in the length and form of the spinous processes, and in the place of origin of the transverse processes, indicate the tail to have been relatively shorter in the Iguanodon than in the Crocodile. Assuming, however, that the number of caudal vertebræ of the Iguanodon equalled that in the Crocodile, and allowing to each vertebra with its intervertebral space $4\frac{1}{2}$ inches, we obtain the length of 12 feet 6 inches for the tail of the Iguanodon. On the foregoing data, therefore, we may liberally assign the following dimensions to the largest Iguanodon:

	<i>Feet.</i>
Length of head, say . . .	3
Length of trunk with sacrum . . .	12
Length of tail . . .	13
	<hr/>
Total length of the Iguanodon . . .	28

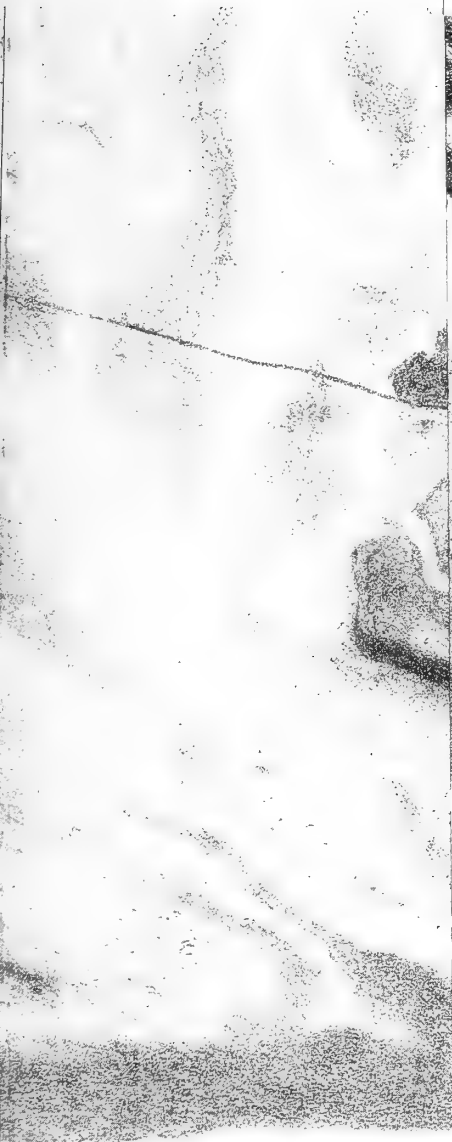
The same observations on the general form and proportions of the animal, and its approximation in this respect to the Mammalia, especially the great extinct Megatherioid or Pachydermal species, apply as well to the Iguanodon as to the Megalosaurus.

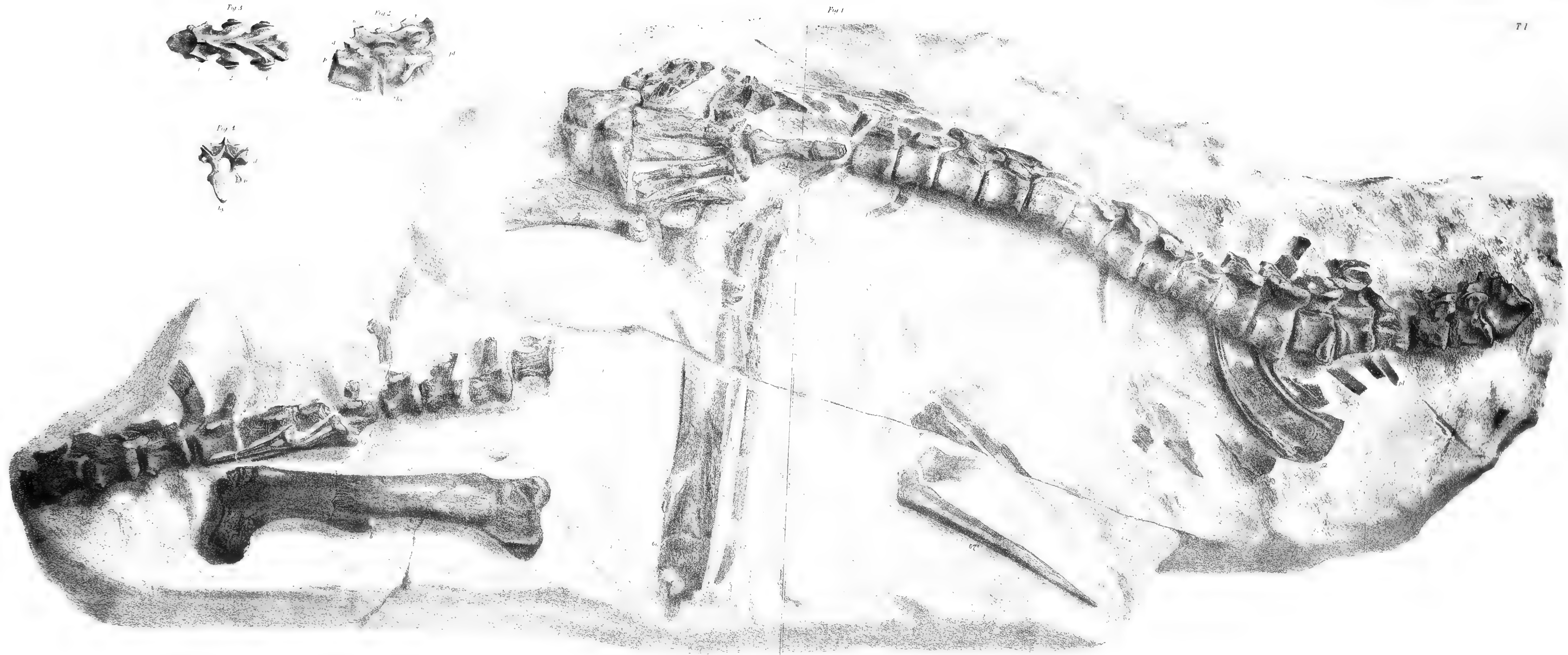
* See also the judicious remarks by Dr. Buckland to the same effect, 'Bridgewater Treatise,' p. 244.

TAB. I.

Chief part of the vertebral column, with some bones of the extremities, of a young
Iguanodon ; nat. size.

From the Wealden of Cowleaze Chine, Isle of Wight. In the British Museum, and
that of J. S. Bowerbank, Esq., F.R.S.





TAB. II.

Iguanodon Mantelli ; one fourth nat. size.

Fig.

1. Upper or vertebral portion of a thoracic rib, front view.
2. Back view of the same rib.
3. Upper view of the vertebral end of a thoracic rib, showing the ridge continued upon the long neck.
4. A considerable portion of a succeeding thoracic rib.
5. Upper view of the vertebral end of the same rib.
6. A considerable portion of a succeeding thoracic rib.
7. Upper view of the vertebral end of the same rib.
8. An almost entire rib from about the middle of the thorax.
9. An anterior thoracic rib.
10. Upper view of the vertebral end of the same rib.

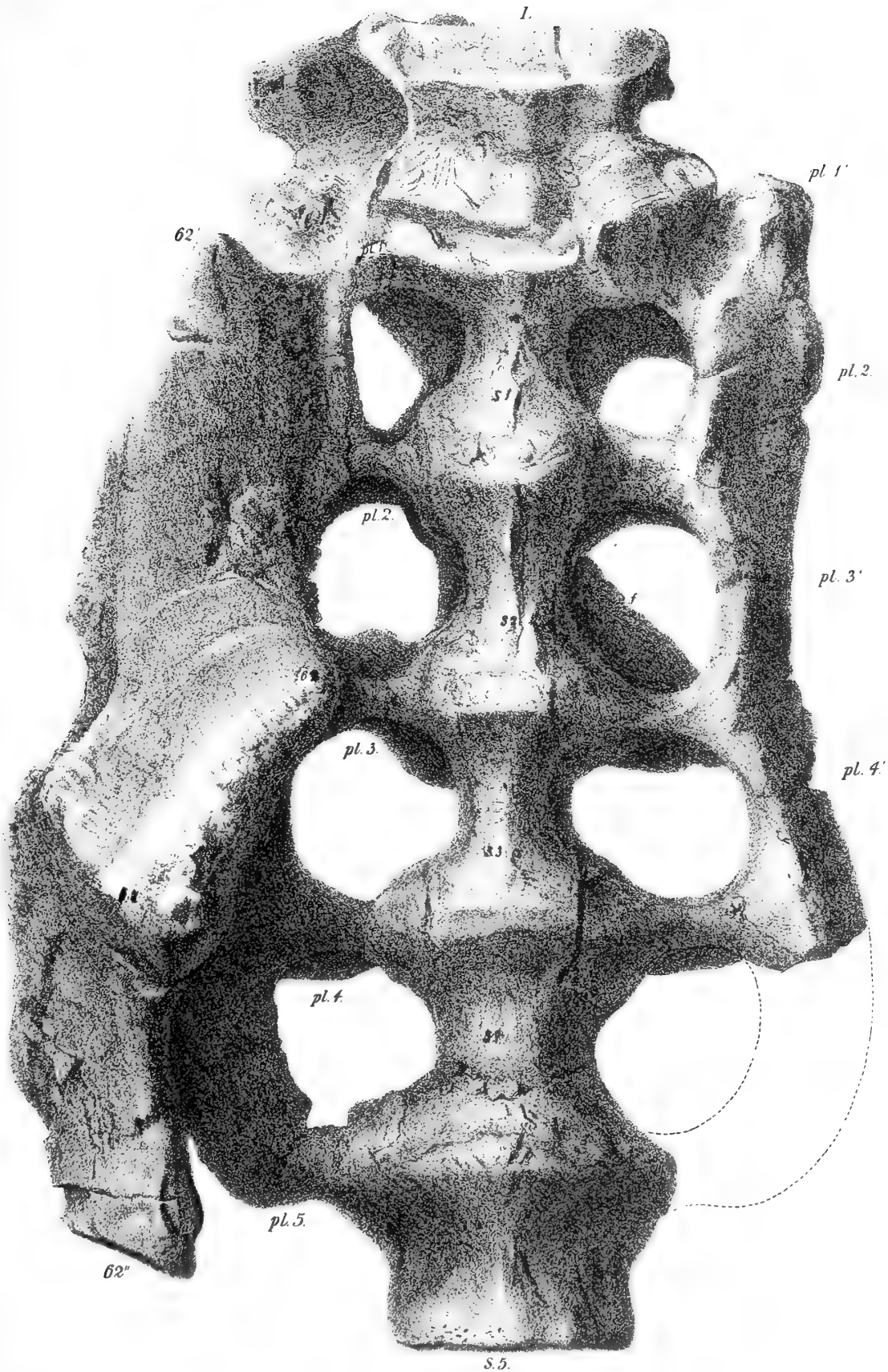
From the Wealden of Tilgate forest. In the British Museum.



TAB. III.

The inferior or ventral surface of the sacrum, and some anchylosed bones of the
Iguanodon ; half nat. size.

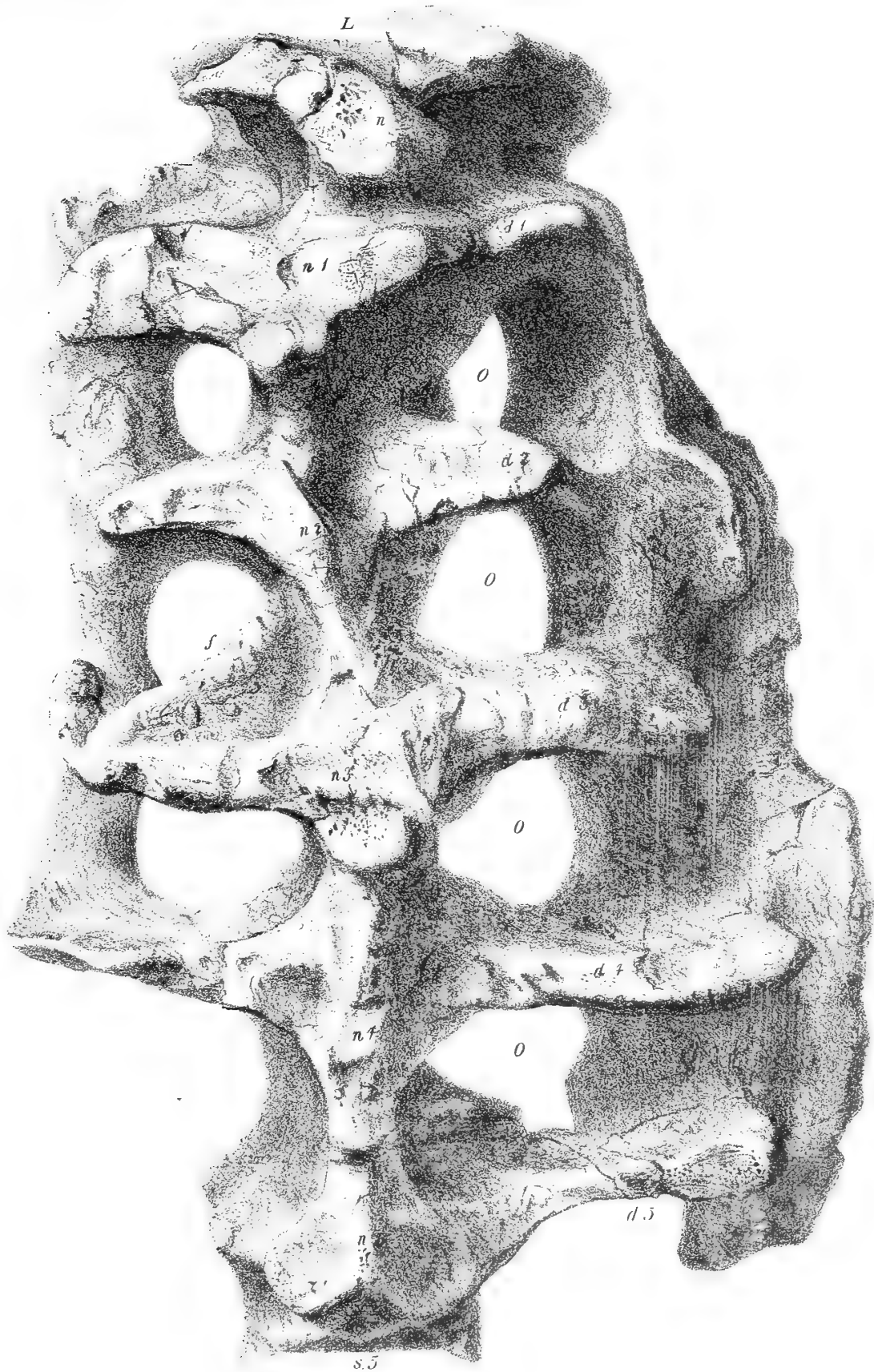
From the Wealden, near Brook-point, Isle of Wight. In the Museum of
W. D. Saull, Esq., F.G.S.



TAB. IV.

The superior or dorsal surface of the sacrum, and some anchylosed bones of the
Iguanodon ; half nat. size.

From the Wealden, near Brook-point, Isle of Wight. In the Museum of
W. D. Saull, Esq., F.G.S.



TAB. V.

Fig.

1. Right side of the sacrum, and anchylosed ilium of the *Iguanodon* ; half nat. size.
2. Left side of the sacrum, and anchylosed lumbar vertebra of the same *Iguanodon*.

From the Wealden, near Brook-point, Isle of Wight. In the Museum of
W. D. Saull, Esq., F.G.S.

Fig. 1.

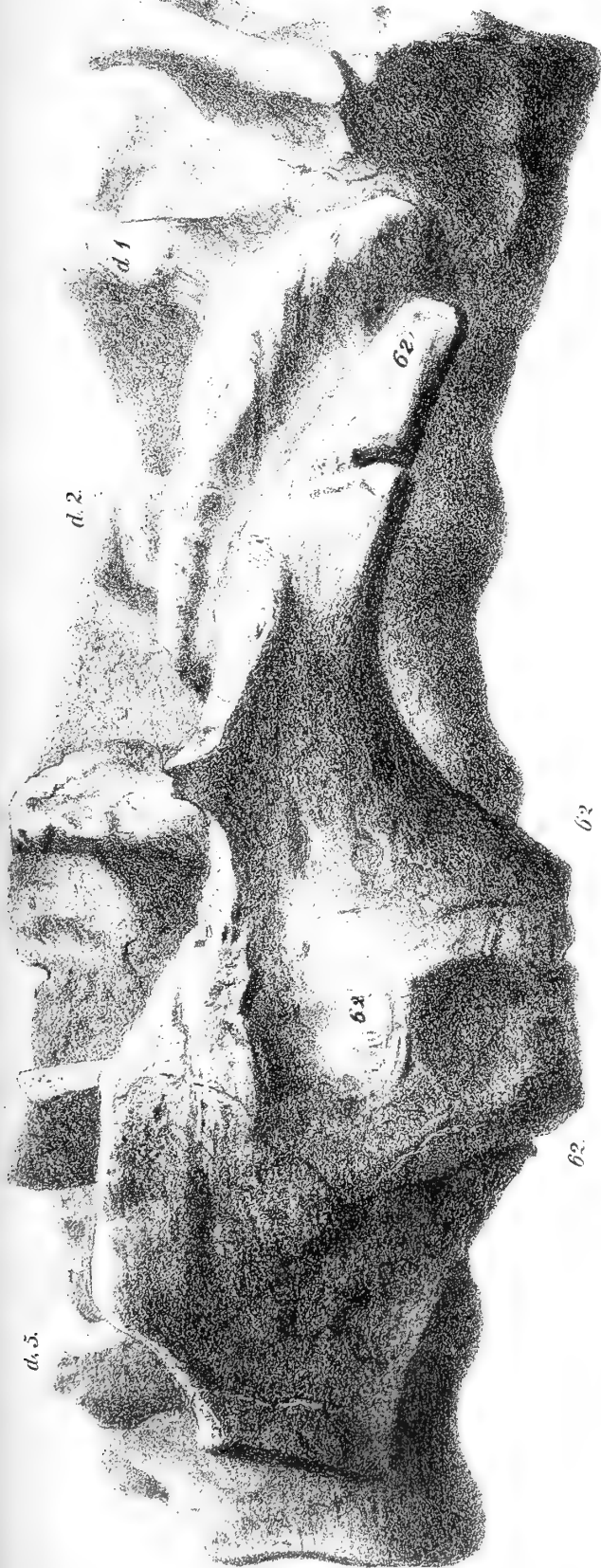
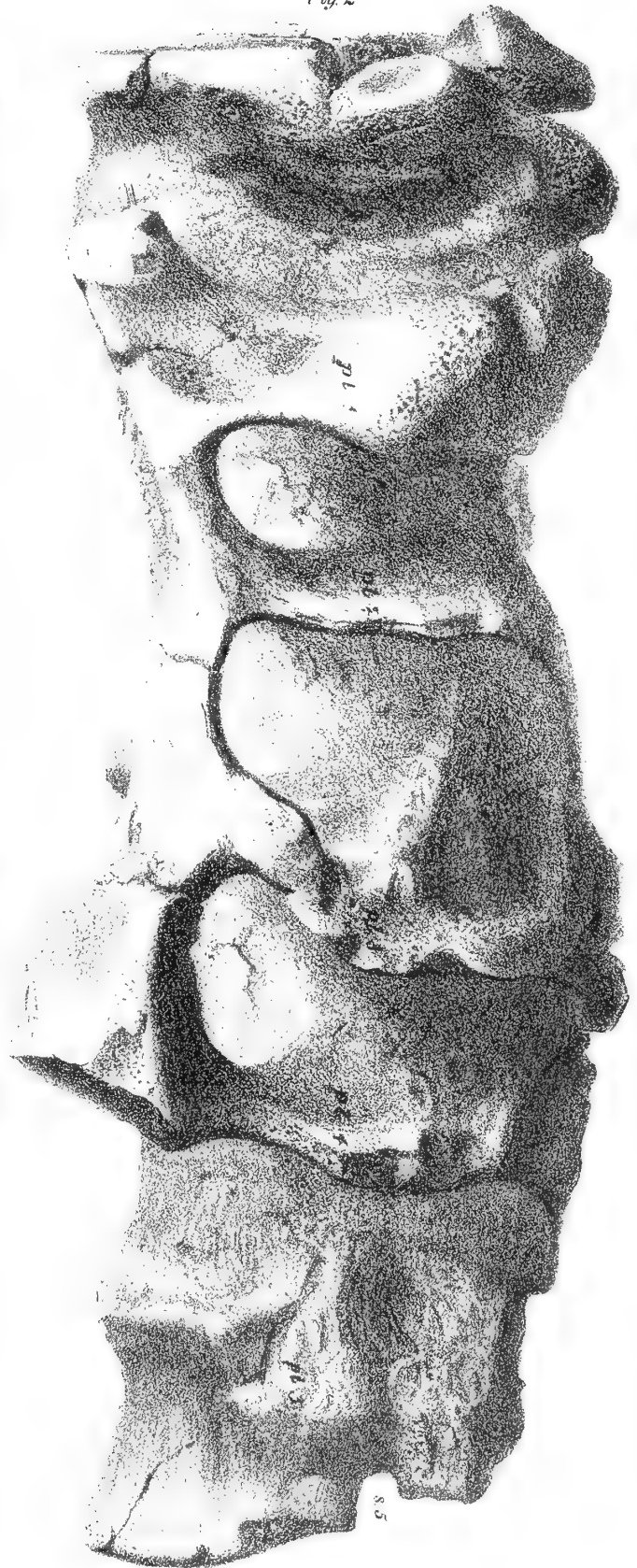


Fig. 2.



TAB. VI.

Fig.

1. Front view of the last lumbar vertebra anchylosed to the sacrum of the *Iguanodon* ;
half nat. size.
2. Back view of the sacrum with the anchylosed right iliac bone of the *Iguanodon*.

From the Wealden, near Brook-point, Isle of Wight. In the Museum of
W. D. Saull, Esq., F.G.S.

Fig 1.

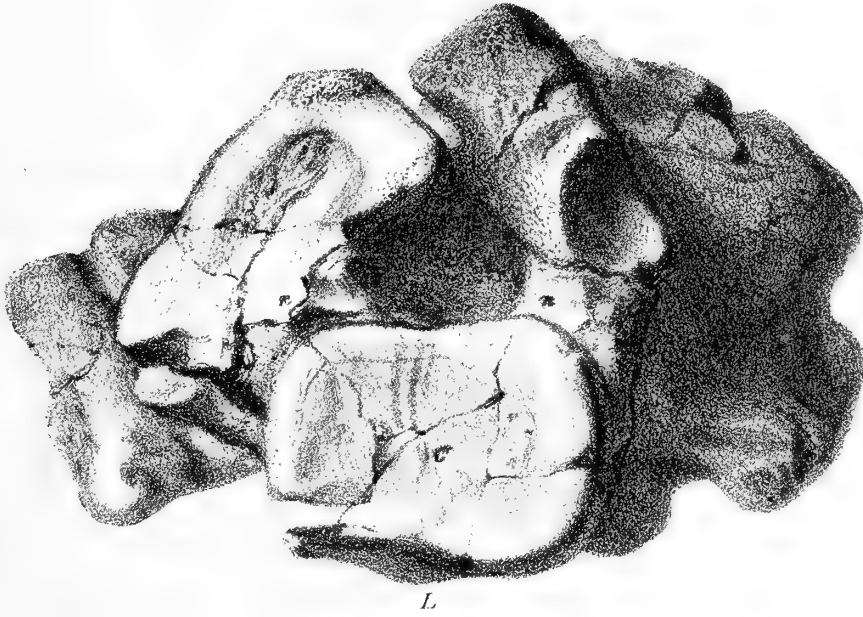


Fig 2



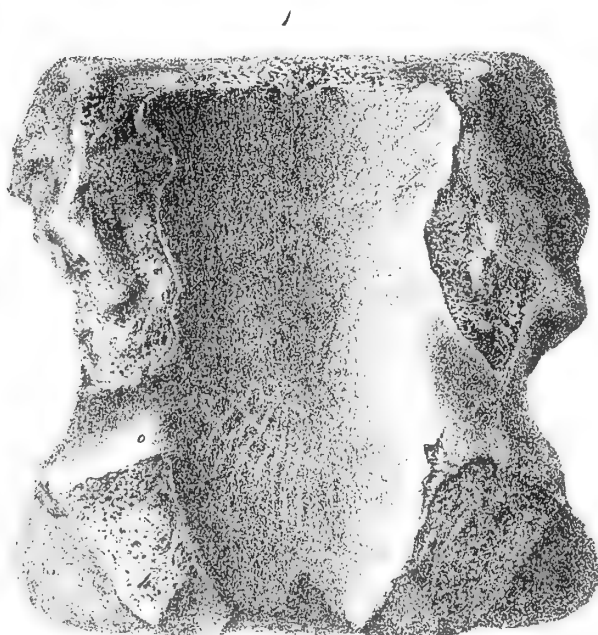
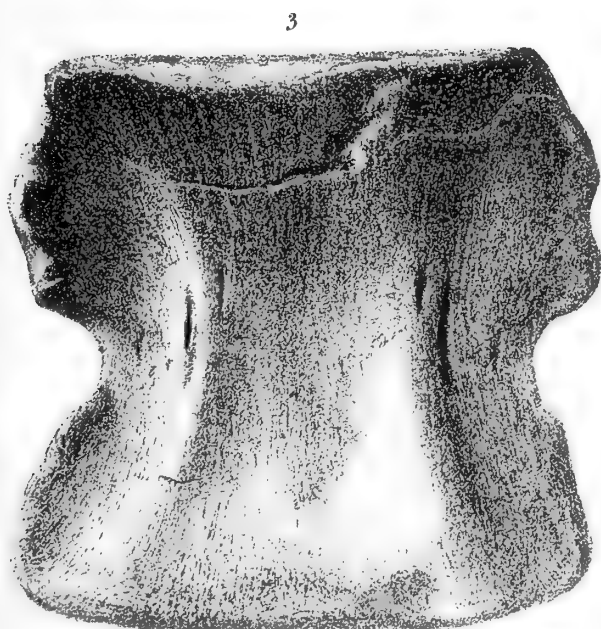
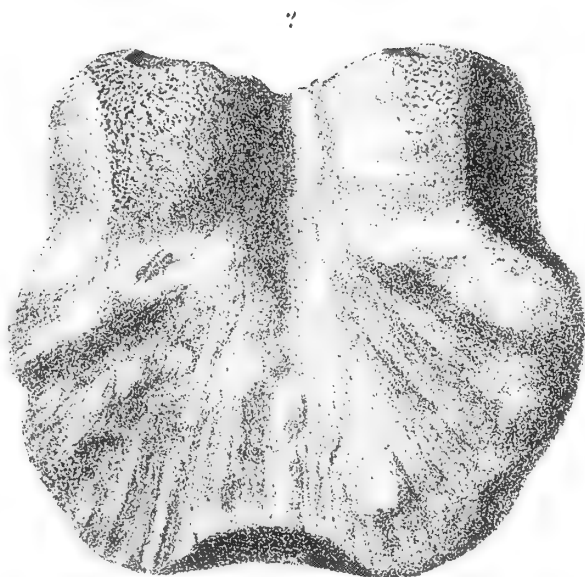
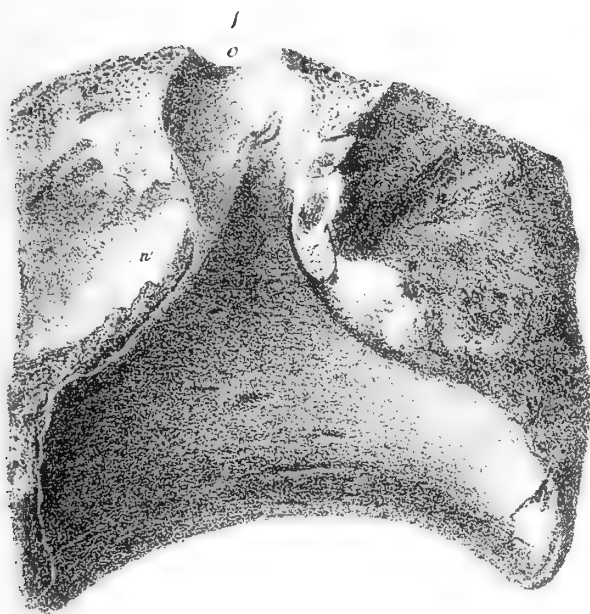
TAB. VII.

The body of the fourth sacral vertebra of a young *Iguanodon* ; nat. size.

Fig.

1. Side view.
2. Front view.
3. Under view.
4. Upper view, showing the place of the escape of the sacral nerves at *o o*.

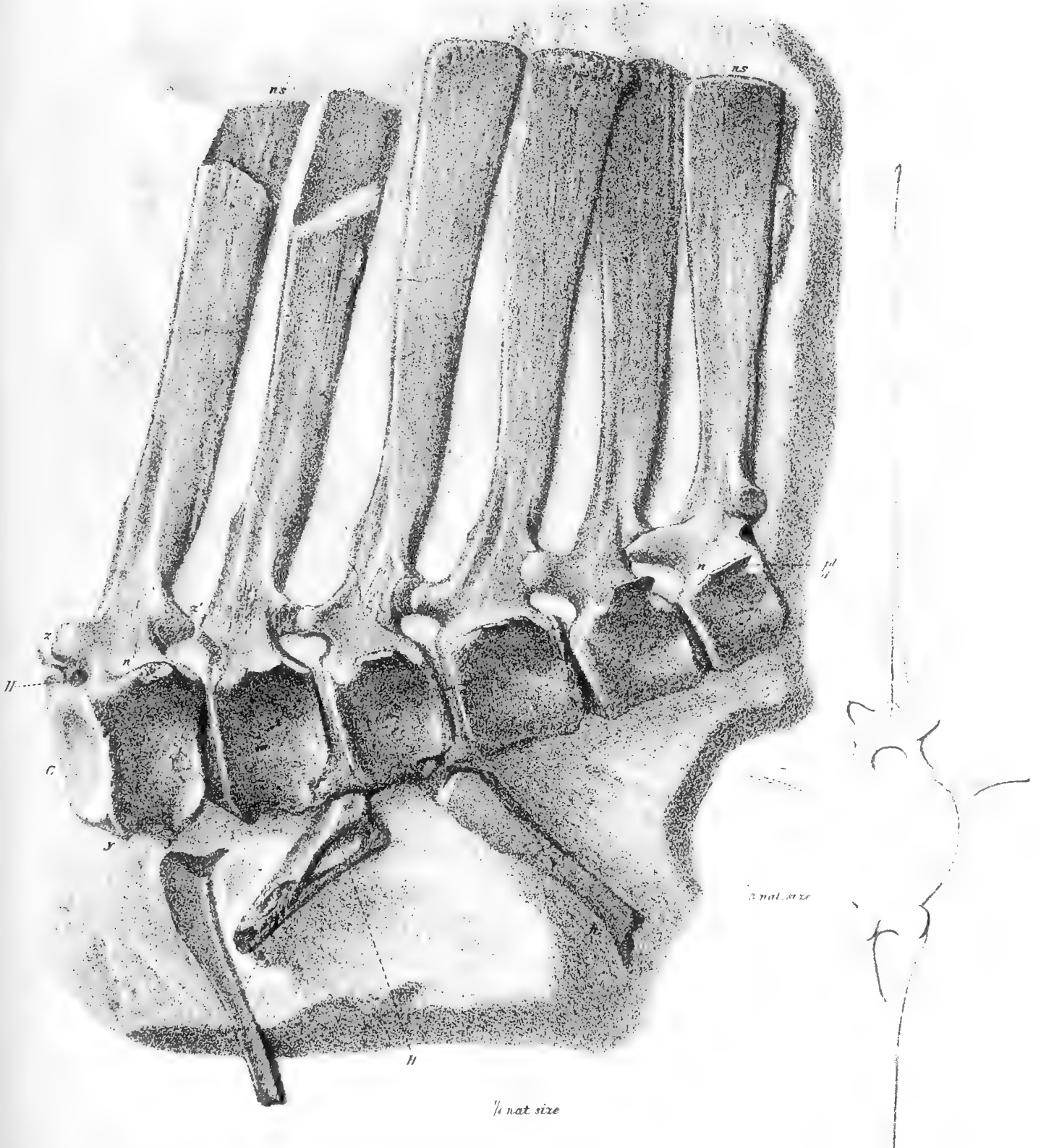
From the Wealden of Tilgate Forest, Sussex. In the British Museum.



TAB. VIII.

Six consecutive vertebræ from the fore part of the tail of the *Iguanodon Mantelli*; one third nat. size. An outline of a front view of the first of these vertebræ; restored and adjoined.

From the Wealden at Cuckfield, Sussex. In the British Museum.



$\frac{1}{4}$ nat size

TAB. IX.

A vertebra probably behind the middle of the tail of the *Iguanodon*; two thirds nat. size ; the hæmal arch is wanting, and the neural spine is mutilated.

Fig.

1. Side view.
2. Upper view.
3. Front view.
4. Back view.
5. Under view.

From the Wealden at Stammerham, Sussex. In the Museum of J. B. Holmes, Esq.

Fig. 2.

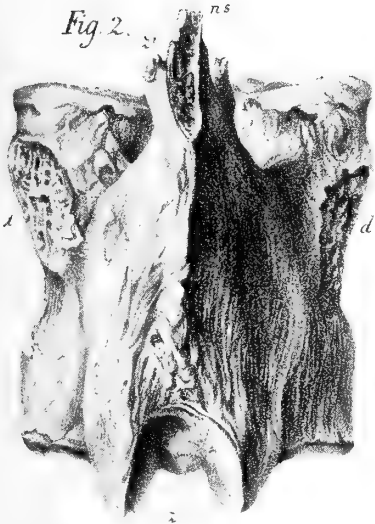


Fig. 5.

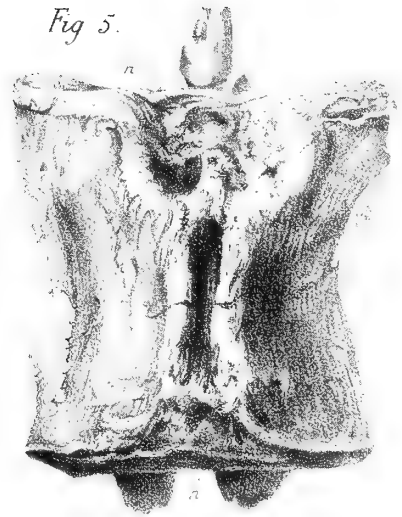


Fig. 1.

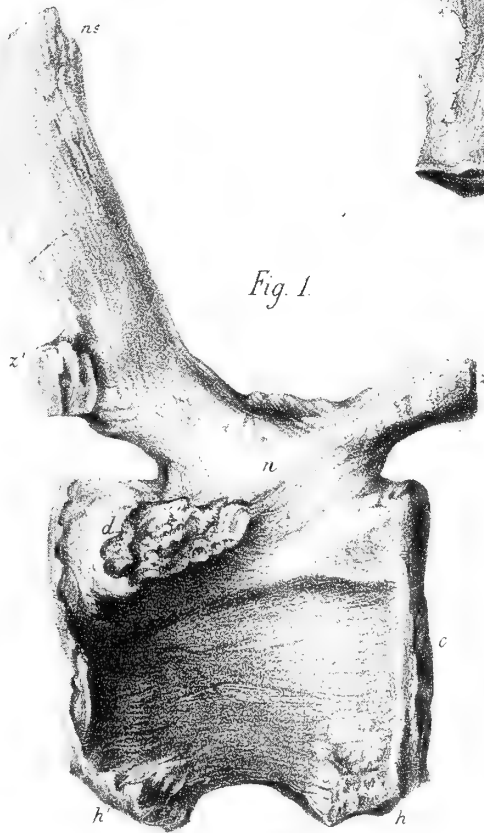


Fig. 4.



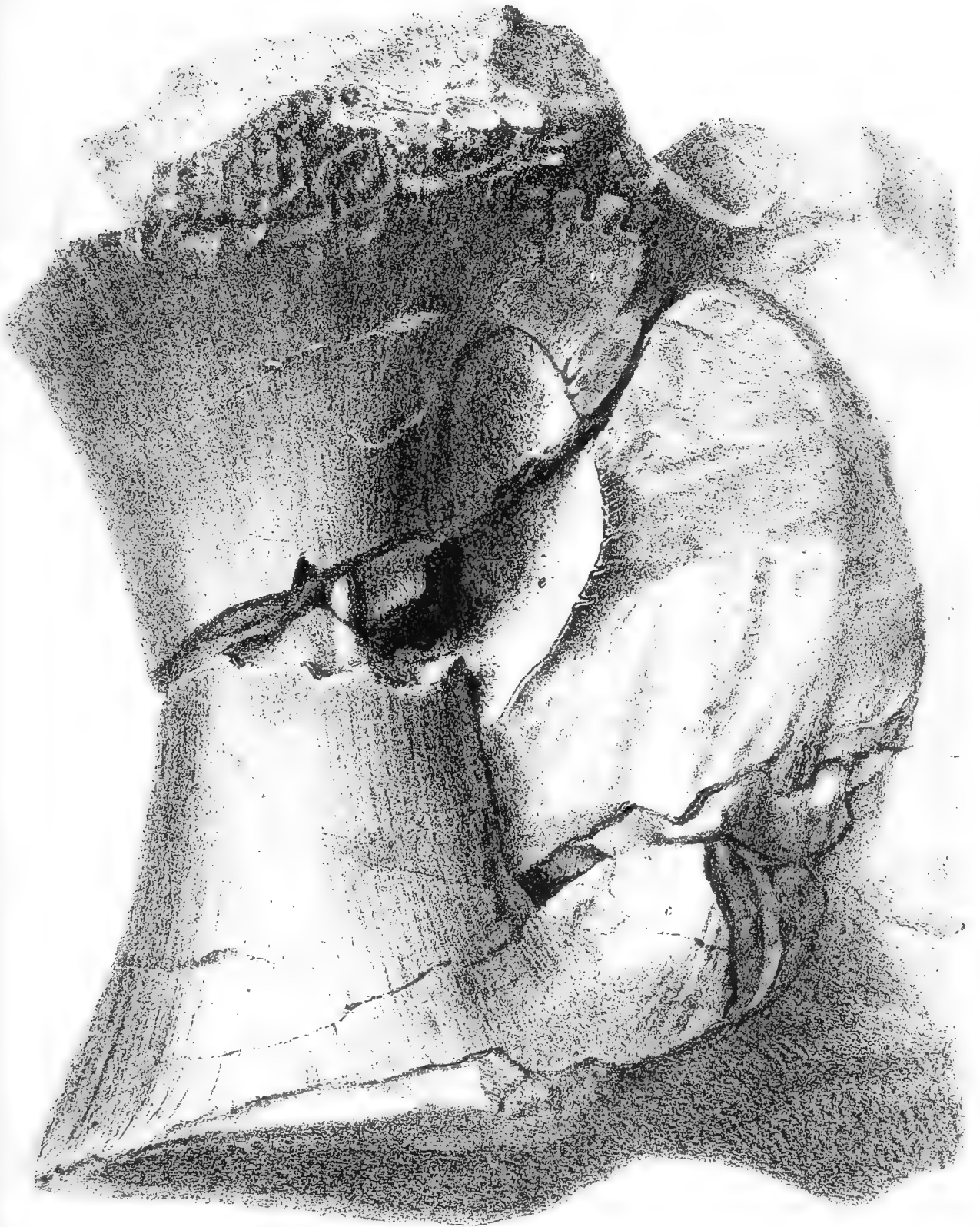
Fig. 3.



TAB. X.

The tympanic bone of an *Iguanodon?* nat. size.

From the Wealden of Tilgate forest, Sussex. In the British Museum.



TAB. XI.

The dentary part of the right branch of the lower jaw of a young *Iguanodon*; nat. size.

Fig.

1. Outside view.
2. Inside view, showing the alveolar depression, and the germs of some successional teeth.

From the Wealden of Stammerham, Sussex. In the Museum of J. B. Holmes, Esq., of Horsham.

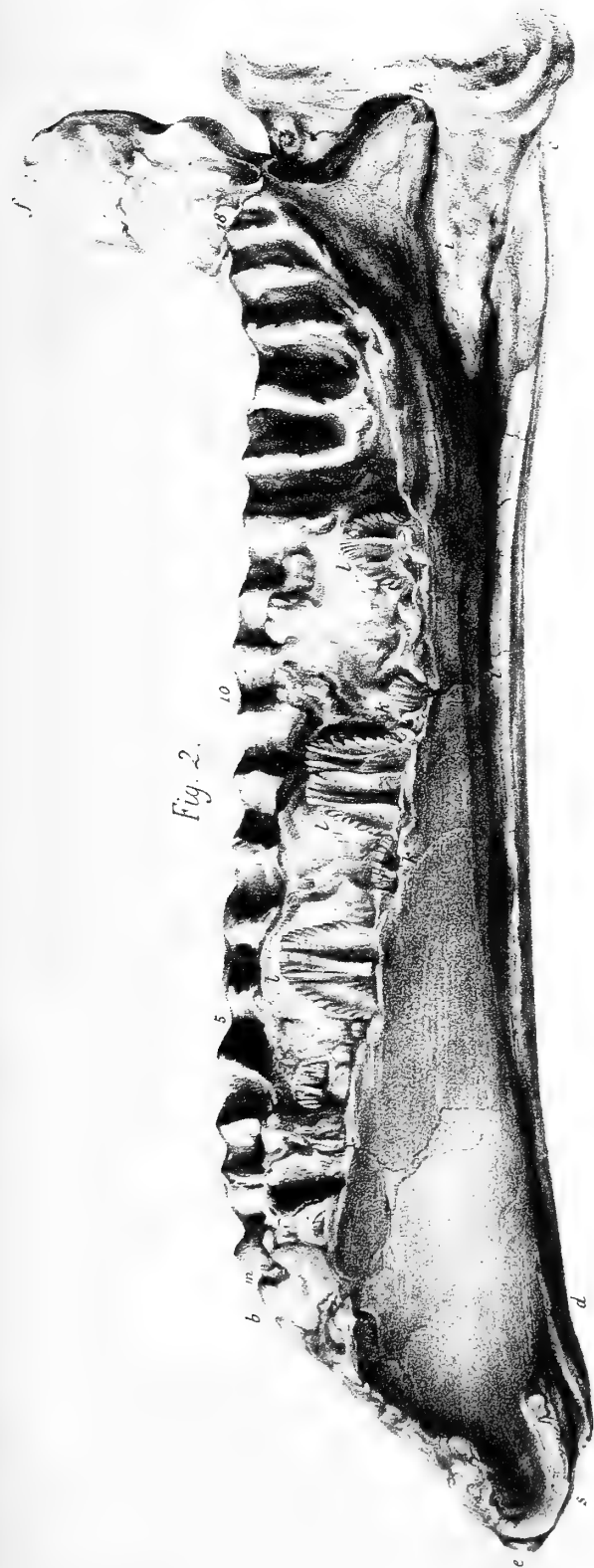


Fig. 2.

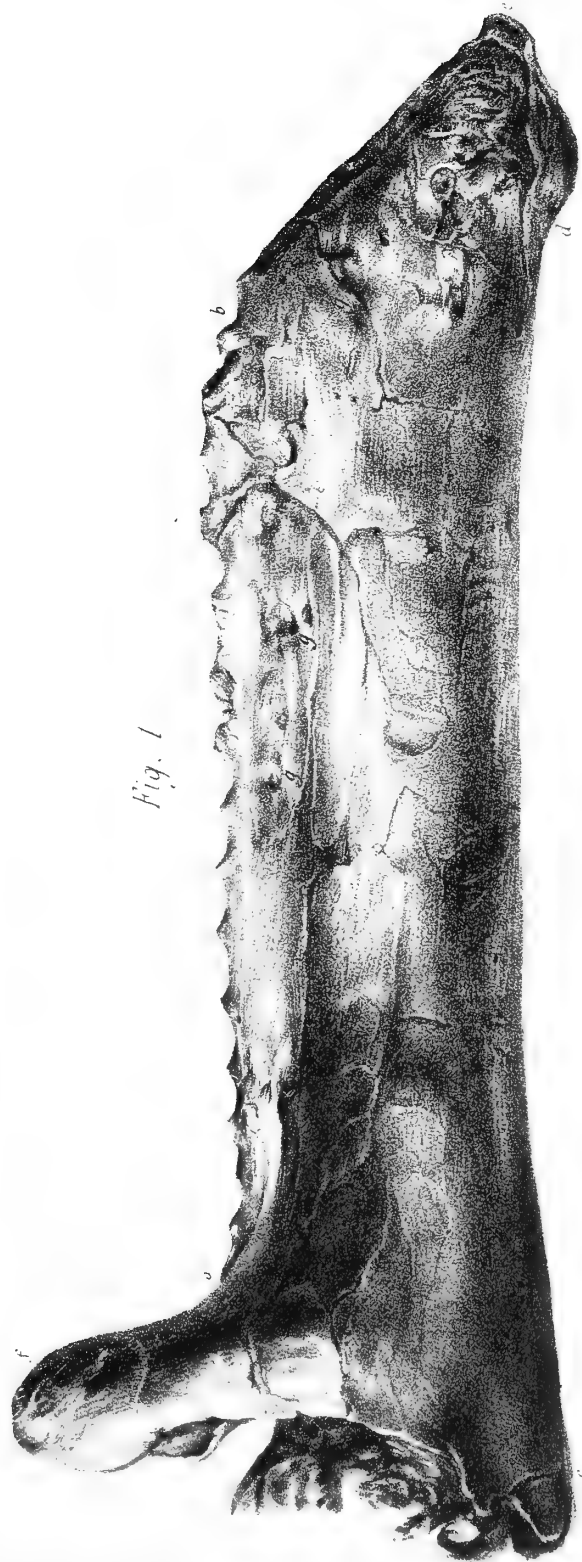


Fig. 1.

TAB. XII.

The same portion of lower jaw, as in Tab. XI, of a young *Iguanodon*; nat. size.

Fig.

3. Upper view.

4. Under view.

From the Wealden of Stammerham, Sussex. In the Museum of J. B. Holmes, Esq.
of Horsham.

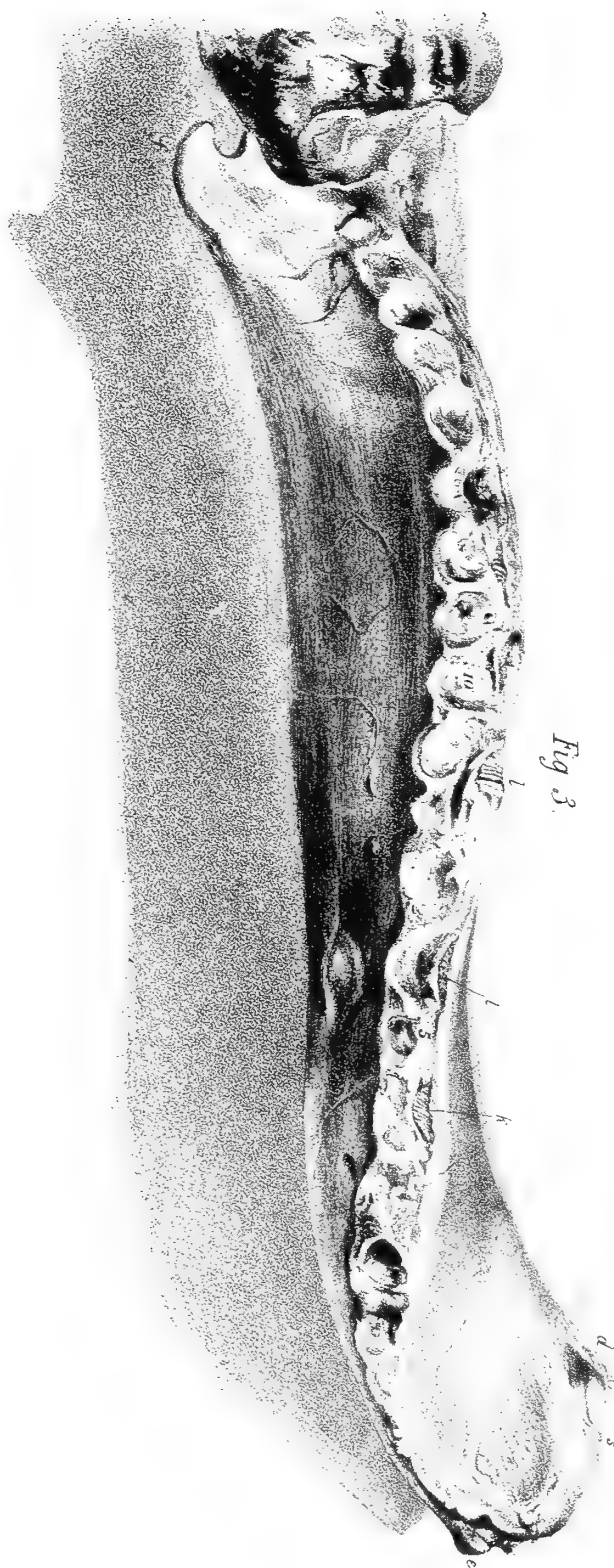


Fig. 4.



TAB. XIII.

Portions of the upper and lower jaws of the *Iguanodon*; nat. size.

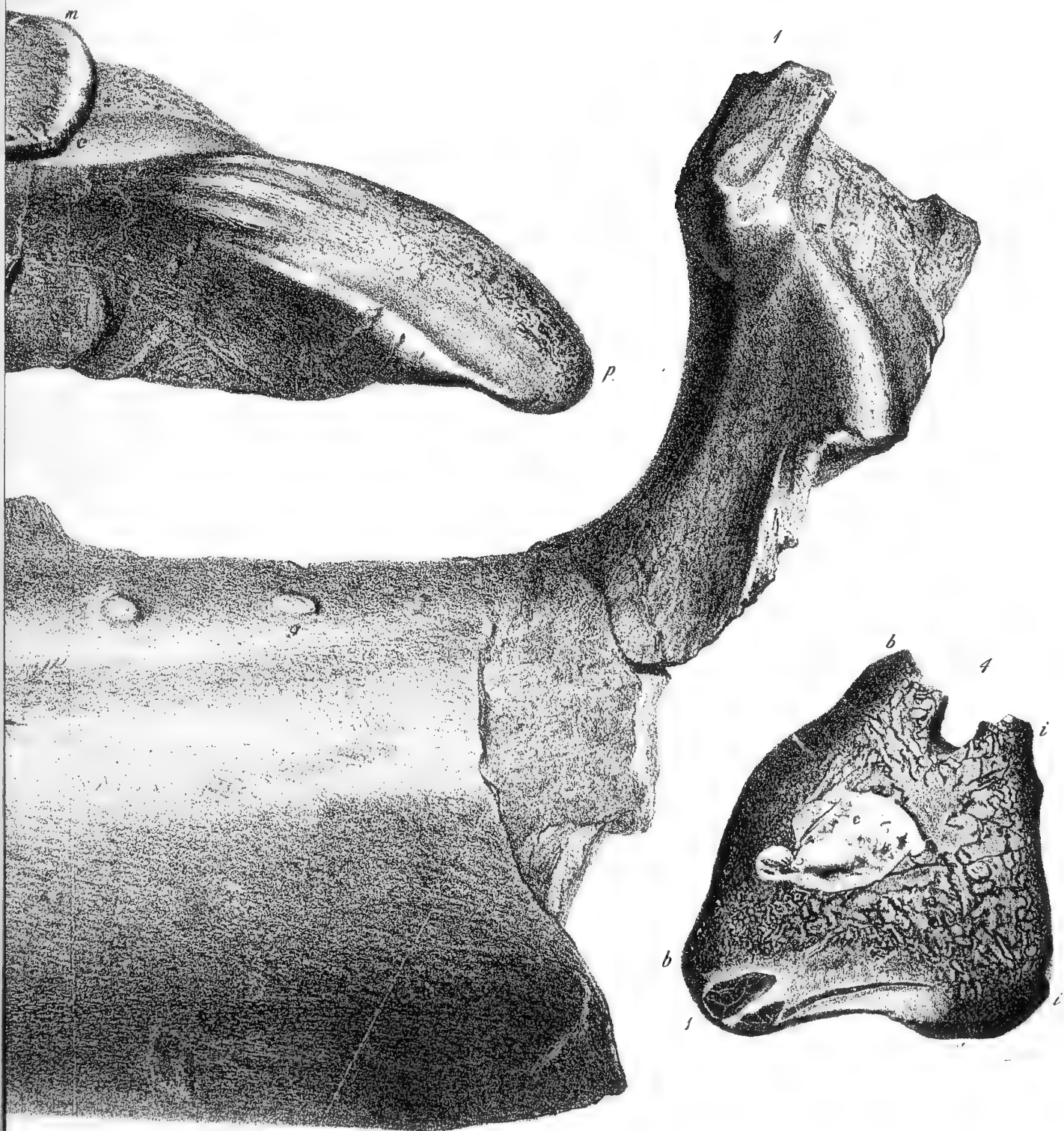
Fig.

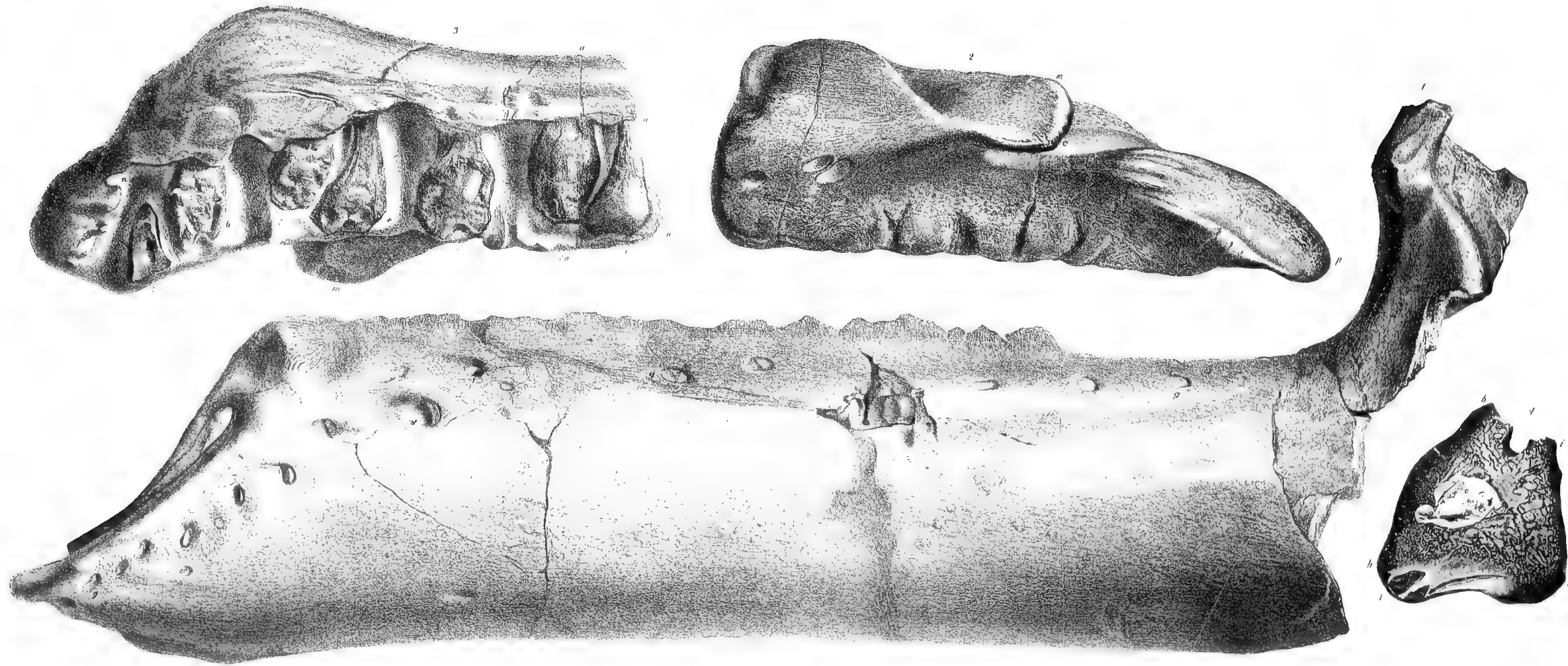
1. The dentary part of the lower jaw of a large, probably full-grown *Iguanodon*; nat. size.

From the Wealden of Tilgate, Sussex. In the British Museum.

2. The outer side of a portion of the back part of the left superior maxillary bone of a probably full-grown *Iguanodon*; nat. size.
3. The inner side of the same specimen.
4. The cut surface of a vertical section taken through the fore-part of the same specimen.

From the Wealden near Brook-point, Isle of Wight. In the British Museum.





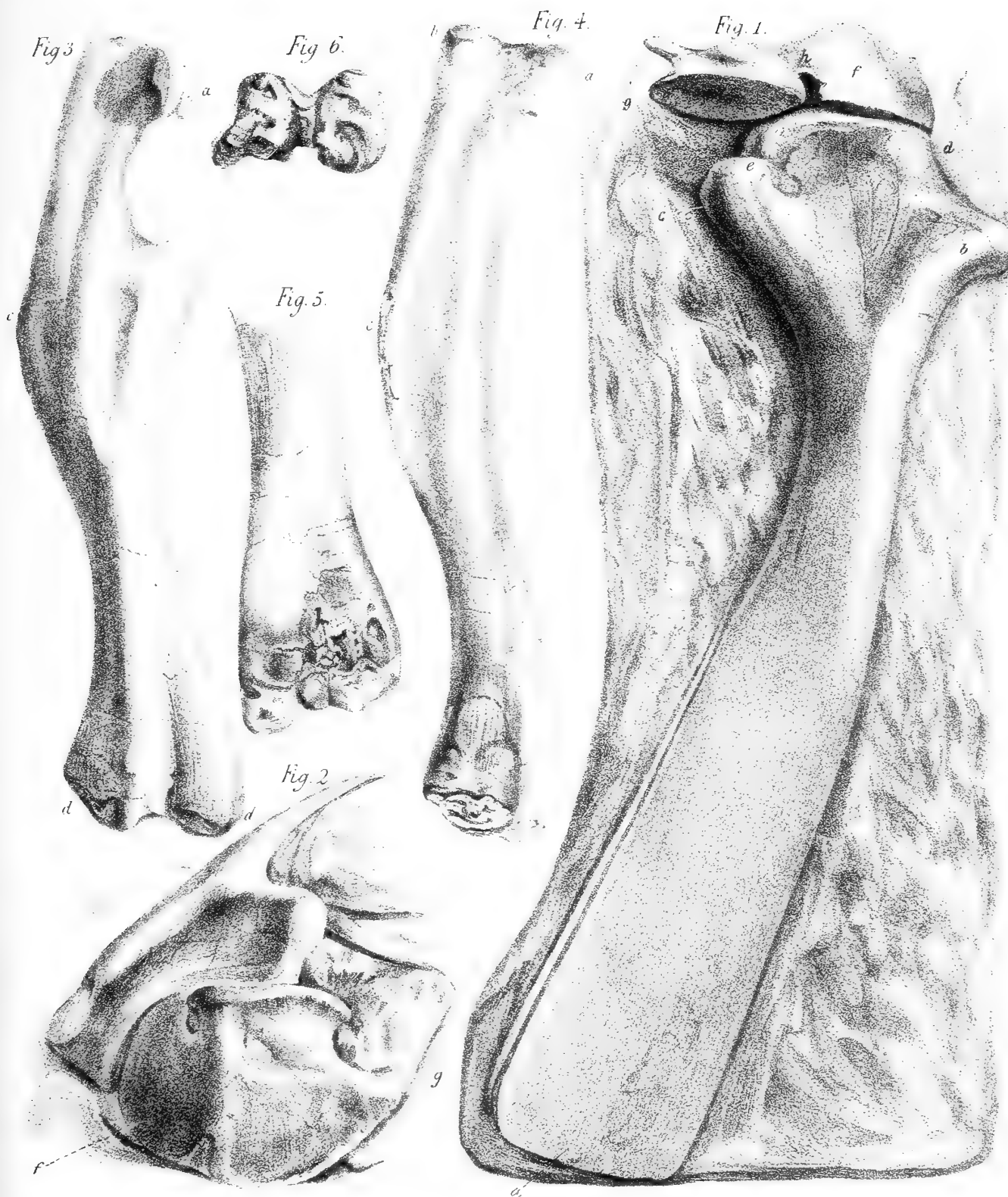
TAB. XIV.

Iguanodon Mantelli ; one third nat. size.

Fig.

1. The scapula and coracoid (the upper end is downwards in the figure).
2. An end view of the same specimen showing the coracoid.
3. Front view of the humerus of the same individual.
4. Side view of the same humerus.
5. Back view of the lower half of the same humerus.
6. Condyles of the same humerus.

From the Wealden at Rusper, Sussex. In the Museum of J. B. Holmes, Esq.



TAB. XV.

Iguanodon Mantelli; one fourth nat. size.

Fig.

1. Front view of the right femur : 1*a*, Outline of the head of the bone : 1*b*, Outline of the condyles of the bone.
2. Back view of the right tibia of a somewhat larger individual.

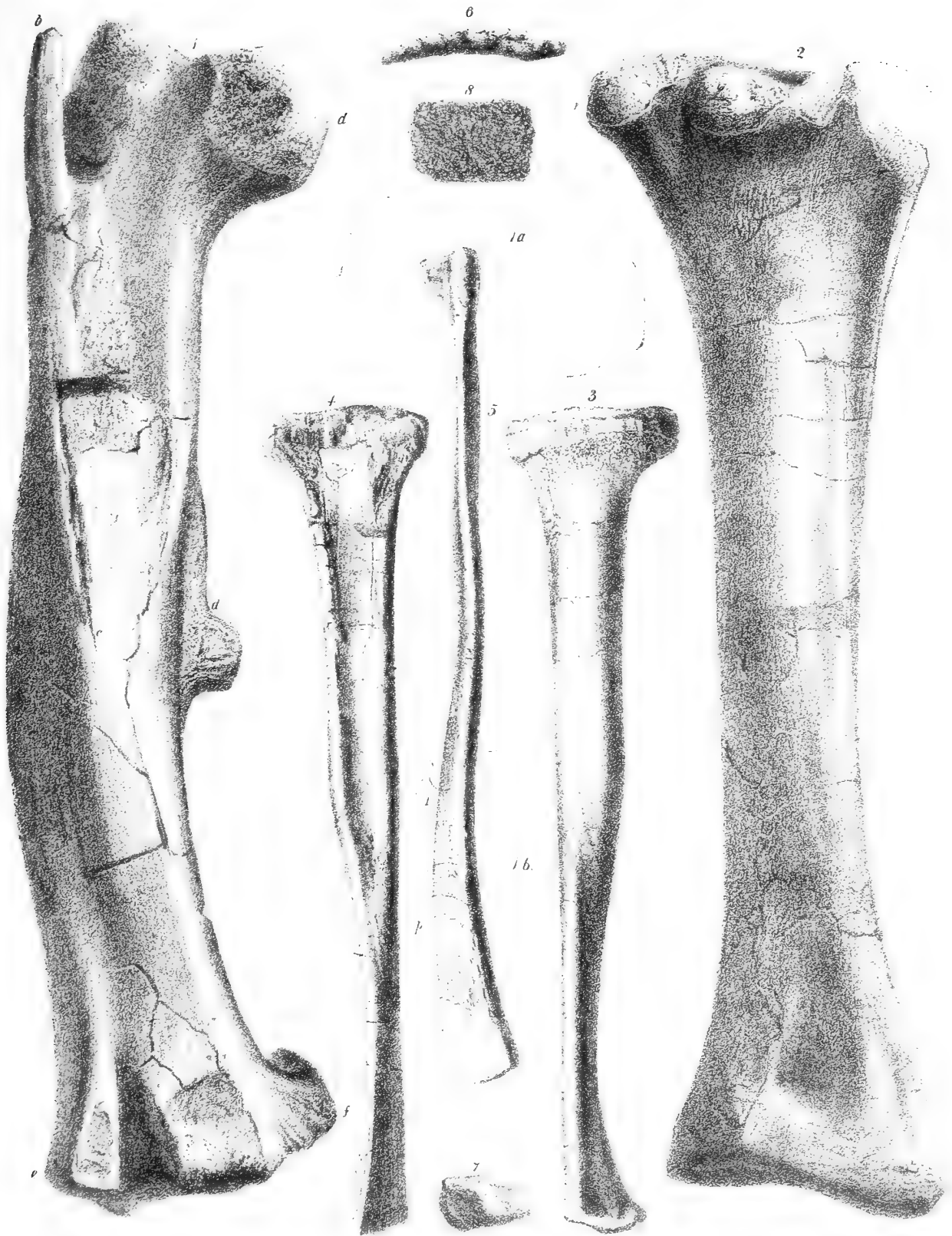
From the Wealden of Tilgate Forest, Sussex. In the British Museum.

3. Outside view of the fibula of a younger *Iguanodon*.
4. Inside view of the same bone.
5. Front view of the same bone. (The upper end of the bone is downwards in these figures.)
6. Lower end of the same bone.
7. Upper end of the same bone.

From the Wealden of Sussex. In the Museum of J. B. Holmes, Esq., of Horsham.

8. A slightly magnified view of the surface of a piece of the corium or true skin of the *Iguanodon*.

From the specimen in Tab. I; from the Wealden of Cowleaze Cline. In the Museum of J. S. Bowerbank, Esq., F.R.S.



TAB. XVI.

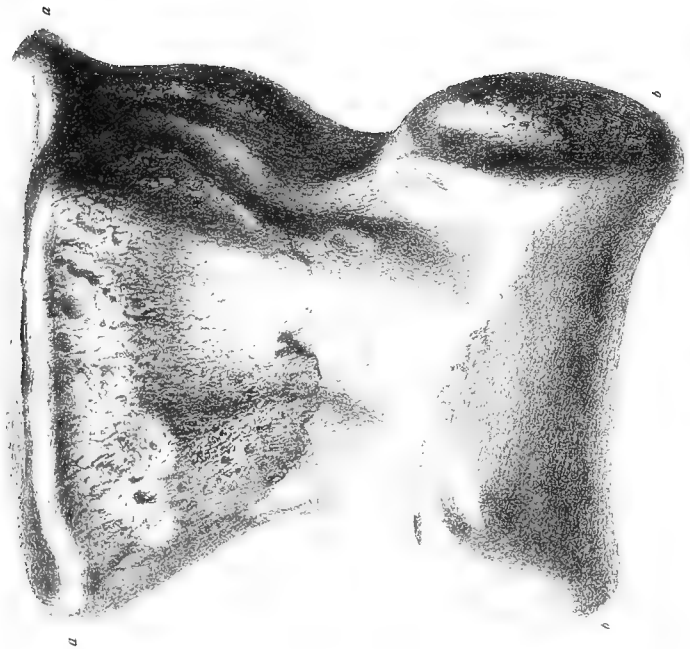
Fig.

1. A first or proximal phalanx of one of the toes of an *Iguanodon*; nat. size.
2. A last or ungual phalanx of one of the toes of an *Iguanodon*; nat. size.

From the Wealden of the South coast, Isle of Wight. In the Geologic
Museum of Oxford.



6







TAB. XVII.

Ungual phalanges of modified shape, probably from the extreme toe, outer or inner, of the hind foot of the *Iguanodon*.

Figs. 1 and 2, are of the specimen called '*Horn of the Iguanodon*,' in the Works and Catalogue of Dr. Mantell.

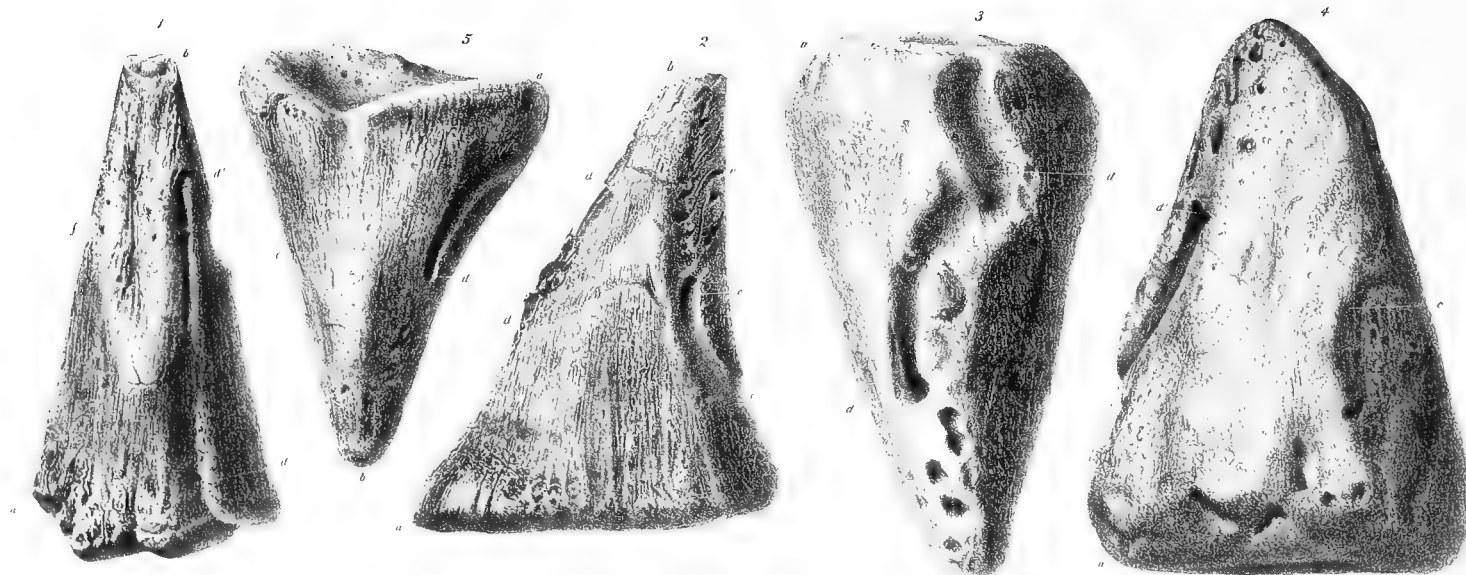
From the Wealden, Sussex. In the British Museum.

Fig.

3. Side view of a similarly shaped phalanx.
4. Upper view of the same phalanx.
5. Upper view of a smaller and similar phalanx.

From the Wealden of Battle, Sussex. In the Museum of Felix Knyvett, Esq.

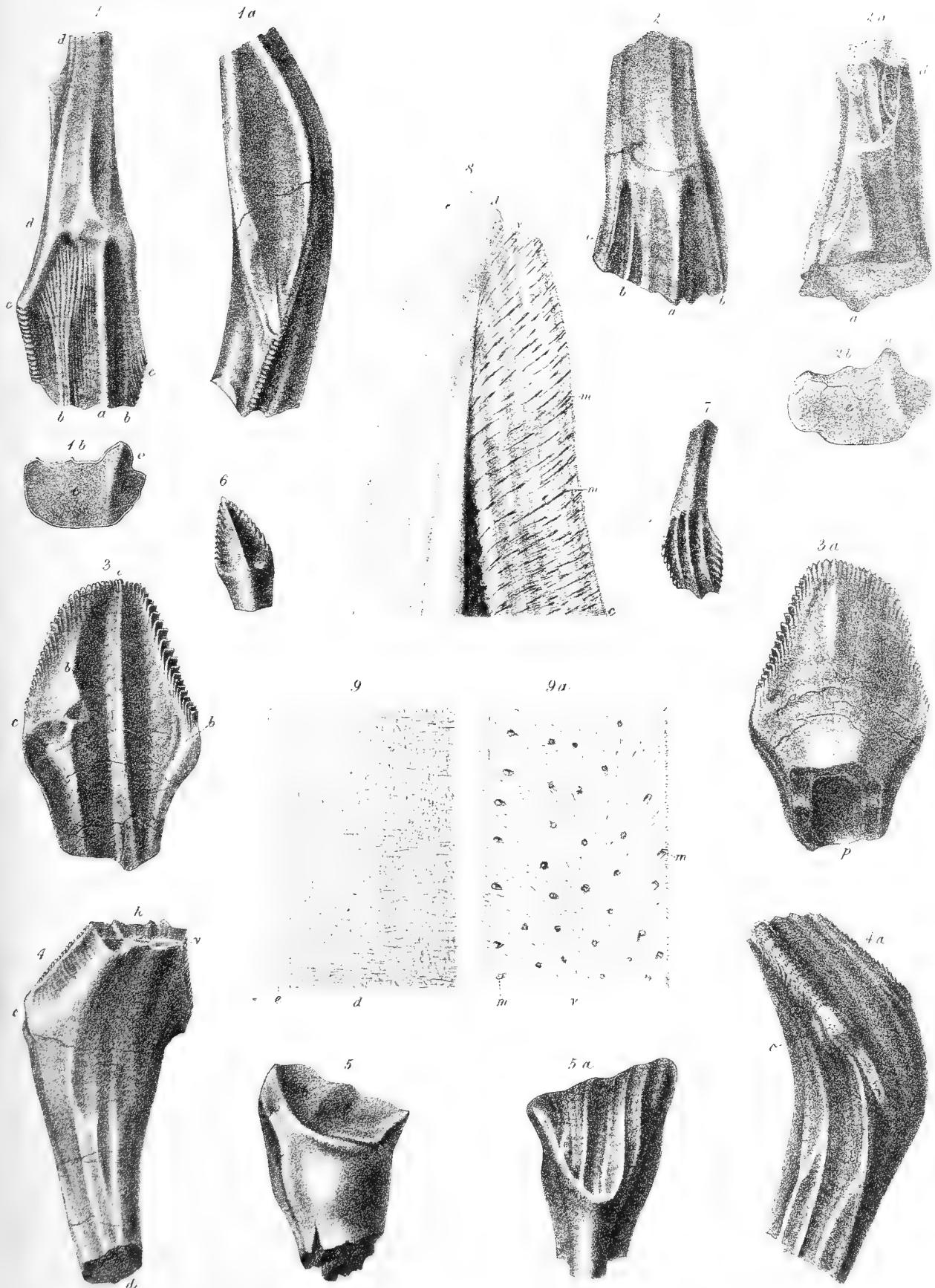




TAB. XVIII.

Different views of the teeth from the upper and lower jaws of the *Iguanodon*; figs. 1—7, nat. size: figs. 8 and 9, highly magnified views of sections, showing structure.

From the Wealden of Tilgate Forest; and Cuckfield, Sussex. In the British Museum.



TAB. XIX.

Megalosaurus Bucklandii; nat. size.

Three anterior dorsal vertebræ: *p*, parapophysis, or lower transverse process: *t*, accessory tubercle contributing some attachment to the head of the rib: *d*, diapophyses, or upper transverse process, fractured, which gave attachment to the tubercle of the rib: *b*, oblique buttress extending from the parapophysis to the diapophysis, and contributing to the support of the neural platform: *z*, the prozygapophysis, *z'*, the zygapophysis, forming the ends of the neural platform and articulating the neural arches of the vertebræ with each other, *ns*, the neural spine of the foremost of these vertebræ, *ns'*, the neural spine of the second vertebra; it expands at its extremity, overhangs the anterior shorter spine, and develops a strong bony plate from its back part which fixes it to *n''*, the similarly developed and modified spine of the third vertebra.

The extraordinary size and strength of the spines of these anterior dorsal vertebræ, indicate the great force with which the head and jaws of the *Megalosaurus* must have been used.

From the Wealden, near Battle. In the Museum of Samuel H. Beckles, Esq., F.G.S.





THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLIV.

A MONOGRAPH
OF THE
MOLLUSCA FROM THE GREAT OOLITE,

CHIEFLY FROM
MINCHINHAMPTON

AND
THE COAST OF YORKSHIRE.

BY
PROFESSOR MORRIS, F.G.S. AND JOHN LYCETT.

LONDON:
PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.
1854.

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PART III.
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OPIS SIMILIS, Sow., sp. Tab. VI, figs. 4, 4a.

CARDITA SIMILIS, Sow. Min. Con., p. 56, t. 232, f. 3, 1819.

OPIS SIMILIS, Morris. Catal., p. 96, 1843.

Testá subrhomboidéa, fornicatá, concentricè lineatá, umbonibus terminalibus incurvis, cariná dorsali acutá, latere postico abrupto, lunulá planá. (Goldfuss.)

Shell nearly rhomboidal or cordiform, elongated; umbones terminal, rather angulated and incurved; dorsal surface with an elevated acute angle; the lunule is very small and cordiform, its borders rounded; the anterior portion of the surface has concentric lines, which pass over the carina, and are soon lost upon the flattened posterior surface.

The height, measured along the dorsal carina, very much exceeds the lateral diameter, the shell being much produced and pointed at the posterior and inferior extremity; it is associated with *Opis lunulatus* in the shelly beds of the Great Oolite, but is much less common; compared with that species it is much more lengthened and oblique, the lunule minute, and the lines are much more delicate and closely arranged.

Localities. Minchinhampton and Bisley Commons in the Great Oolite; Ancliff, Wiltshire; Ponton, Lincolnshire. Cloughton Wyke, Yorkshire. (Phillips.)

OPIS DESHAYESII. Tab. VI, figs. 5, 5a.

Testá elongatá, angustá, trapeziformi, concentricè costatá, anticè depressá, posticè acute-carinatá, sublævigatá, subsinuatá; costis regularibus depressis; lunulá magná excavatá, marginibus rotundis; umbonibus elatis, angustis, incurvis.

Shell elongate, narrow, trapeziform, the sides concentrically costated; anterior side depressed, truncated; posterior side acutely carinated, the carina separating a posterior depressed and smooth area from the costated portion of the shell; the posterior margin of the shell forms an angle at its middle part; lunule large and deep, its margins rounded; umbones elevated, angulated, and compressed at the sides.

The general figure is compressed, elongated, and attenuated, irregularly pentagonal, the anterior side being the most wide. The absence of an anterior angle is sufficient to distinguish it from *Opis cardissoides*, Goldfuss; but the two species which approach most nearly to it are the *Opis Archiaciana* and *O. Michelinea*, figured and described by M. Buvignier in his work on the 'Geology and Palæontology of the Department of the Meuse;' but in neither of the latter species does the convexity of the valves equal that of our shell; they are comparable to it in the elevation and attenuation of the umbones, but are destitute of the regular concentric costæ.

Height, $5\frac{1}{2}$ lines; opposite diameter, $3\frac{1}{2}$ lines; diameter through both the valves, 4 lines. Rare.

Localities. Quarhouse, Bisley Common, and Minchinhampton Common; Ancliff, Wiltshire.

ASTARTE. *Sow.*, 1817.

Gen. Char. Shell equivalve, inequilateral, thick, the surface usually concentrically costated, the margins of the valves close, and internally crenulated. Hinge with two diverging cardinal teeth in each valve, those of the left valve being elongated and nearly equal, those of the right valve unequal, the anterior one being small. Muscular impressions two; ligament external.

ASTARTE SQUAMULA, *D'Archiac.* Tab. IX, fig. 9.

ASTARTE SQUAMULA, *D'Archiac.* Mém. Soc. Geol. Fr., vol. v, pl. 25, f. 5.

Testá ovato-orbiculari, subdepressá, umbonibus medianis acutis, lunulá ovato-lanceolatá, costis concentricis, crebris, irregularibus et depressis, nonnunquam obsoletis.

Shell ovately orbicular, rather flattened; umbones mesial, prominent, and acute; lunule ovately lanceolar, and but little excavated; hinge margin lengthened and rounded; concentric costæ numerous, irregular, and depressed, sometimes obsolete.

The valves of this little depressed species occur in considerable numbers throughout the shelly beds of the formation in the Minchinhampton district; in the greater number of instances the surface is smooth, probably by erosion. The lateral diameter is one fifth greater than the height, and in the largest examples does not exceed six lines. Individuals vary moderately, both in the outline and the convexity of the valves, but a considerable number can easily be obtained for comparison.

Localities. Minchinhampton. Eparcy, France.

ASTARTE MINIMA, *Phil.* Tab. IX, fig. 10a, b.

ASTARTE MINIMA, *Phil.*, Geol. Yorksh., t. 9, f. 23.

? ASTARTE PULLA, *Roemer*, Nordd. Ool., p. 113, t. 6, f. 26.

Testá convexá, ovato-orbiculari; umbonibus submedianis; costis regularibus convexis, interstis æqualibus (circa 14).

Shell convex, ovately orbicular; umbones nearly mesial; costæ (about fourteen in number) regular, rounded, elevated, and equal in breadth to the interstitial spaces.

This little shell is not associated with any other at all resembling it, but from its minuteness, it is probably often unnoticed; it does not appear to be abundant (at least in the Minchinhampton district, from which our specimens have been obtained).

The lateral diameter exceeds the height by about one third, and rarely equals 4 lines.

Localities. Minchinhampton Common, in the soft beds of Oolite beneath the planking; Ponton, Lincolnshire; Scarborough, in the grey limestone of the Great Oolite.

ASTARTE PUMILA, Sow. Tab. IX, fig. 13a, b.

ASTARTE PUMILA, Sow. Min. Con., t. 444, f. 2, p. 64.

— — ? Goldfuss. Petref., t. 134, f. 16.

— — Morris. Catal. Brit. Foss., 1854, p. 187.

Testá parvá, convexá, ovatá, umbonibus acutis, postmedianis, antrorsum incurvis, lunulá parvá, mediocre depressá, costulis regularibus, obtusis, crebris, interstiis angustioribus.

Shell small, convex, ovate; umbones acute, postmesial, but directed somewhat forwards; lunule small, moderately depressed; concentric costæ regular, obtuse, closely arranged, the interstitial spaces very narrow.

The height is always greater than the lateral diameter, a character which differs from the shell figured by Goldfuss, the latter probably being a different species; the depression of the lunule varies in different individuals, but never has the deep concavity figured by Goldfuss. The height is usually about 3 lines; it is somewhat rare.

Localities. Ancliff and Minchinhampton.

ASTARTE EXCENTRICA. Tab. IX, fig. 8a, b.

Testá parvá, ovato-orbiculari convexá, umbonibus medianis acutis, lunulá minimá; plicis incrementi paucis, magnis et irregularibus; costis crebris depressis, interstiis angustioribus; costis superioribus subundatis, excentricis, inferioribus semel subundulatis sed concentricis.

Shell small, ovately orbicular and convex; umbones mesial and pointed; lunule very small; folds of growth few, strongly marked, and irregular; costæ very densely arranged, depressed, the interstitial spaces very narrow; the superior costæ are slightly undulated, and are excentric, passing across the surface of the valves very slightly inflected; the inferior costæ are concentric, but are likewise slightly undulated.

The finely ornamented surface of this little shell is scarcely visible except under a magnifier; the costæ are flattened, and so closely arranged that the interstitial spaces are mere striæ; there is also about the borders of the costæ a kind of obscurely wrinkled appearance, or as though they were slightly crenulated; the superior or excentric costæ occupy a surface less than the inferior ones, and the two kinds are separated by a prominent fold of growth. Our little species does not appear to be very abundant, it occurs with other small shells of the same genus in the beds of soft shelly Oolite which underlie the planking.

Height and lateral diameter equal, or about 4 lines.

Localities. Minchinhampton and Bisley Commons.

ASTARTE ROTUNDA. Tab. IX, fig. 12.

ASTARTE ORBICULARIS, Sow. Min. Con., t. 520, f. 2.

— ROTUNDA, Morris. Catal. Brit. Foss., p. 187.

Testá crassá orbiculatá, convexá, umbonibus submedianis acutis, margine cardinali obliquo, elongato, subrecto, lunulá magná lanceolatá, plicis incrementi paucis, irregularibus; costis depressis, crebris et irregularibus.

Shell thick, orbicular, convex; umbones nearly mesial, prominent, acute; hinge margin oblique, lengthened, and nearly straight; lunule large and lanceolate; folds of growth few and irregular; costæ depressed, small, closely arranged, and irregular.

The general figure has a considerable degree of convexity; the umbones are small, pointed, and curved forwards, and are placed somewhat nearer to the anterior than posterior side of the valves; the extremity of the lengthened hinge border forms an angle with the inferior margin. It is rare.

Height nearly equal to the lateral diameter, which is $2\frac{1}{4}$ inches; the diameter through both the valves is $1\frac{1}{2}$ inch.

Locality. Minchinhampton Common, in the planking.

ASTARTE? RHOMBOIDALIS, Phil., sp. Tab. IX, fig. 20.

ISOCARDIA RHOMBOIDALIS, Phil. Geol. York., 1, t. 3, f. 28.

HIPPOPODIUM LUCIENSE, D'Orb. Prod. Paléont., p. 308.

— BAJOCIENSE, D'Orb. Ib., p. 277.

Testá crassá convexá, subquadrátá, vel oblongá, umbonibus anticis obtusis, margine cardinali elongato, subhorizontali, lunulá magná, excavatá, margine inferiore subrecto et sinuato, marginibus internis integris, superficie plicis incrementi paucis, magnis, distantibus; striis concentricis tenuissimis regularibus crebris. Ætate senili striis concentricis obsoletis, plicis rugis magnis irregularibus.

Shell thick, convex, subquadrate, or oblong; umbones anterior, obtuse; hinge margin elongated, subhorizontal, but slightly arched; lunule large, elliptical; inferior margin nearly straight, parallel to the superior border, and slightly sinuated; internal margins of the valves plain, acute; folds of growth few, large, and distant; concentric striations regular, delicate, and closely arranged. In an advanced stage of growth the concentric striations disappear, and the surface became rugose with the irregular plications of increase. An oblique prominence or obscure angle extends downwards posteriorly, and becomes prominent in specimens which are short and have the superior border much arched. The Great Oolite examples are very numerous, and for the most part rather flattened and rugose with adherent shells, the largest specimens not unfrequently having been perforated or grooved by the Lithophagidæ; the substance of the test is very thick, and the muscular impressions are deeply excavated; the cardinal teeth are remarkably large and massive.

Localities. The vertical range of this remarkable species is very considerable; it occurs in the Inferior Oolite of the Cotteswolds, the Great Oolite of Minchinhampton, the Coralline Oolite of Malton, and we have seen fine casts from the Kimmeridge Clay of Wilts. The *Hippopodium Luciense* and *H. Bajociense*, D'Orb., are probably identical with this species.

ASTARTE EXCAVATA, Sow., var. COMPRESSIUSCULA. Tab. IX, fig. 18, 19.

ASTARTE EXCAVATA, Sow. Min. Con., t. 233.

— COMPLANATA, Roemer. Nordd. Oolith., t. 6, f. 28.

Testá ovatá, transversá, compressá, umbonibus parvis anticis depressis, margine cardinali, elongato, carvato, subhorizontali, margine inferiore elliptico, lunulá angustá excavatá, margine acuto. Costis externis concentricis depressis irregularibus interdum confertis aut enim obsoletis. Ætate juniore testá planatá et fragili, costis paucis latis prominulis.

Shell ovately transverse, compressed; umbones small, anterior, and much depressed; hinge border elongated, nearly horizontal, and curved; lower border regular, elliptical; lunule deeply excavated, its margins acute; concentric costæ depressed, irregular, sometimes nearly obsolete. In the young state the shell is flattened, very delicate, pellucid, and has a few distinct broad concentric costæ near to the umbones.

In the shelly beds of the Great Oolite, the young delicate shells occur abundantly from 3 to 6 lines in length. Adult specimens are much more rare, and few exceed 20 lines in length.

The tenuity of the test is considerable; and this feature, together with the greater flatness, will serve to distinguish it from the typical form, *A. excavata*, Sow., which is a much larger and thicker shell. Notwithstanding its tenuity, flatness, and the small dimensions, we believe this to be only a variety of the well-known Inferior Oolite shell, induced by peculiarities of the stratum in which it occurs. The same change of aspect takes place in the freestone beds of the Inferior Oolite; but the form again attains its pristine dimensions and thickness in the upper ragstones higher in the series.

Localities. Minchinhampton Common in the Great Oolite; Nailsworth Hill, in the freestone beds of the Inferior Oolite.

The typical shell occurs abundantly at Dundry and at Rodborough Hill.

ASTARTE DEPRESSA, Goldf. Tab. IX, fig. 11.

ASTARTE DEPRESSA, Goldfuss. Petref., p. 192, t. 134, f. 14.

Testá compressá, transversim ovato-orbiculari; umbonibus medianis obtusis; lunulá ellipticá, angustá, costis convexis interstitiisque concentricè striatis. (Goldfuss.)

Shell compressed, transverse, ovately orbicular; umbones median, prominent, obtuse;

lunule elliptical, narrow; cardinal margin nearly straight, oblique; concentric costæ convex, irregular, with fine interstitial concentric striæ.

The lateral diameter is one fifth greater than the height; the smaller specimens are those which display the characters of the species most distinctly; with increase of growth the shell acquired some additional convexity, and the costæ became less distinctly elevated.

Locality. It occurs somewhat rarely in the shelly beds of the formation at Minchinhampton, and likewise in the middle division of the Inferior Oolite of the same district.

ASTARTE ANGULATA. Tab. IX, fig. 17*a, b*.

Testá crassá transversá, subtetragoná, aut cuneiformi; umbonibus anticis prominentibus; margine antico rotundato, postico elongato, subrostrato, dorso oblique subinflexo; striis concentricis crebris, irregularibus.

Shell thick, transverse, somewhat triangular or wedge-shaped; umbones prominent and anterior; anterior margin short and rounded; posterior margin elongated, slightly curved, and rostrated; dorsal surface slightly bent by an obscure angle, which passes obliquely downwards to the posterior extremity; striæ concentric, closely arranged, and irregular.

A sulcus borders the posterior side of the shell throughout its length; it is smooth, and the margin separating it from the dorsal surface is acute. This character will readily distinguish it from contemporaneous species of the genus.

This small shell is not very common: it occurs with other small Veneridæ in the soft Oolite which underlies the planking.

Locality. Minchinhampton Common.

ASTARTE ELEGANS, Sow. Tab. XIV, fig 14.

ASTARTE ELEGANS, Sow.	Min. Con., t. 137, f. 3.
—	— <i>Phil.</i> Geol. York., 1, t. 11, fig. 41.
—	— <i>Goldf.</i> Petref., t. 134, f. 12.
—	— <i>Zeiten.</i> Petref., t. 61. f. 4.
—	— <i>Morris.</i> Catal., 1854, p. 186.

Testá ovato-obliquá plano-convexá, crassá; umbonibus antemedianis prominentibus; lunulá excavatá, marginibus rotundis; lateribus plicis concentricis magnis elevatis subacutis, plerumque regularibus; marginibus internis denticulatis.

Shell ovately oblique, with a low convexity; test thick; umbones prominent, anterior, and curved forwards; lunule excavated; border of the valves rounded; surface with large, elevated, and rather acute, usually regular concentric plications; inner margins of the valves denticulated.

Specimens vary much in the degree of obliquity and convexity.

This very common Inferior Oolite species occurs rarely in the Great Oolite, but it is absent in the shelly beds of the formation in Gloucestershire.

Geological position and localities. Minchinhampton and Scarborough in the Great Oolite; the Cotteswolds, Dundry, Yeovil, and Brora in the Inferior Oolite; Malton in the Coralline Oolite.

ASTARTE INTERLINEATA., var. *Lyc.*, sp. Tab. IX, fig. 14, 15a, b.

HIATELLA ? INTERLINEATA, *Lycett*. Ann. and Mag. Nat. Hist., 1850, p. 421.

Testá parvâ subquadratâ vel oblongâ, convexo-planâ; umbonibus acutis, parvis, antemedianis; lunulâ excavatâ; margine superiori et inferiori parallelis subrectis, antico rotundo, postico truncato, angulo obliquo; costis longitudinalibus magnis, postice in angulo flectis et trinodulosis; striis interstitialibus tenuissimis instructis.

Shell small, subquadrate or oblong, slightly convex; umbones acute, small, depressed, and placed anterior to the middle of the valves; lunule excavated; superior and inferior margins parallel, horizontal, and straight; anterior border rounded; posterior border truncated; longitudinal costæ few, somewhat irregular, large, and rounded in the Great Oolite variety, bent posteriorly upwards, forming an acute angle; their posterior portions have also in this variety three rather obscure nodules; the interstitial spaces have very fine longitudinal striations.

This species presents itself under two varieties of aspect, one of which occurs in the middle portion of the Cotteswold Inferior Oolite. This latter and more smooth variety has the figure somewhat shorter, the costæ rather more distant; they are also more narrow and acute; and posteriorly they have not the nodules of the other variety. It must not, however, be inferred that these distinctions are preserved in all specimens; on the contrary, the posterior nodules are uncertain in their distinctness; the number of costæ and their size are equally variable. The test is delicate.

Height, 3 lines; length, $4\frac{1}{2}$ lines; diameter through both the valves, 2 lines: but the greater number of specimens have smaller dimensions.

Geological position and localities. *Astarte interlineata* occurs in the shelly freestone of the Inferior Oolite of Leckhampton and of the Minchinhampton, and likewise in the shelly Great Oolite of the latter locality.

ASTARTE WILTONI. Tab. IX, fig. 16.

Testá ovato-subangulari planatâ, umbonibus anticis acutis; costis apicalibus concentricis paucis, magnis.

Shell ovately subangular or subquadrate, flattened; umbones anterior, acute; the surface with a few acute concentric costæ near to the apex; the other portion of the surface nearly smooth.

The surface ornaments nearly resemble *A. striato-costata*, Munster, Goldf. Pet., tab. 134, fig. 18; but the latter shell has much larger dimensions, is somewhat more convex, and has not the subquadrate figure of our species. It is somewhat rare. The name from John Wilton, Esq., of Gloucester, who has investigated the minute anatomy of the univalve Mollusca.

Lateral diameter, 6 lines; height, 5 lines.

Locality. Minchinhampton Common, in a bed of soft Oolite, which underlies the planking.

ASTARTE RECONDITA, *Phil.*, sp. Tab. XII, fig. 10.

Syn. PULLASTRA RECONDITA, *Phil.* Geol. York., 1, t. 9, f. 13.

Testá parvá, ovato-oblongá, subdepressá; umbonibus obtusis, anticis; margine cardinali subhorizontali, basi ellipticá curvatá, superficie striis concentricis paucis magnis; lunulá excavatá.

Shell small, ovately oblong, rather depressed; umbones obtuse, anterior; hinge border elongated, nearly horizontal; basal margin curved elliptically; lunule excavated; the surface near to the umbones has a few large obscure concentric striations, which disappear towards the middle of the shell.

In figure, this little shell bears some resemblance to the young of *Astarte rhomboidalis*, but it is more flattened, and is destitute of the posterior angle of that species; the few rugose striations near to the umbones is another distinctive feature.

Locality. Ponton, Lincolnshire, where it has occurred rather sparingly in the coarse Oolite. In Yorkshire, Professor Phillips records it in the Great Oolite of Cloughton Wyke.

CYPRINA. *Lam.*

Gen. Char. Shell equivalve, inequilateral, transverse, subglobose or subovate; umbones curved obliquely; ligament external; hinge with three diverging cardinal teeth, and a remote laminar or lateral tooth in each valve; muscular impressions, two, lateral; pallial impression slightly angulated posteriorly; margins of the valves close, smooth internally.

CYPRINA LOWEANA. Tab. XIII, fig. 2 2a—d

Testá transvers im ovali, lævi, convexá; umbonibus antemedianis crassis; lunulá ovatá parvá, areá lanceolatá, latere postico subcompresso, infernè subangulato; striis concentricis tenuissimis irregularibus frequentèr obsoletis.

Shell transversely ovate, smooth, convex; umbones anterior, thick, and large; lunule ovate, but slightly excavated; area lanceolate; anterior side rounded; posterior side rather compressed, and slightly angulated at its inferior extremity; the surface has very fine irregular concentric striations, which in the greater number of instances are obsolete.

In none of the Oolitic forms do we find a greater variety of figure than in this species, and without ample materials for comparison, its examples would probably be regarded as pertaining to more than one species; these variations, which are irrespective of growth, refer to the degree of convexity, the extent to which the valves are produced posteriorly, and the more or less compressed and angulated, or, on the other hand, rounded and convex figure of the posterior side of the shell. The valves occur in such considerable numbers, and so fully illustrate all these minor variations of figure, as to remove all doubt that they belong to the same species, even though we place together two examples of very dissimilar aspect. The shell is rather thin, always very fragile, except at the umbones, which are not unfrequently the only portions preserved when the shelly beds are more than usually detrital in their character. The valves rarely occur in contact; but when this happens the ligament is preserved.

The subjoined proportions must be regarded as representing the median figure of the species. Height, 13 lines; lateral diameter, 15 lines; diameter through both the valves, 10 lines. It ranks as one of the most abundant of the bivalves in the Minchinhampton district, and ranges throughout the shelly beds. Named after J. G. Lowe, Esq., who has assiduously collected an interesting series of fossils from the middle Oolite.

Localities. Minchinhampton Common; Bisley Common.

CYPRINA TRAPEZIFORMIS, et var. SUBROTUNDA. Tab. XIII, fig. 5, 5a, c.

VENUS TRAPEZIFORMIS, Roemer. Verst. Nordd. Oolith., t. 7, fig. 14.

Testá orbiculato-subtrapeziformi, convexo-planá; antice rotundatá; postice subproductá, angulo acuto carinato-depresso; umbonibus anticis incurvis.

Shell orbicular or subtrapeziform, moderately convex; anterior side rounded; posterior side somewhat produced, forming a depressed angle; umbones anterior, incurved.

This small species occurs abundantly throughout the shelly beds of the formation at Minchinhampton, with the valves disunited. When well preserved, its surface exhibits concentric, irregular, and very fine striations; it is shorter and more convex than *C. Loweana*. The form which we have designated as a variety has greater convexity, and the posterior side has not the angulated outline of the typical form.

Dimensions of this variety: height, 8 lines; lateral diameter, 9 lines; diameter through both the valves, 7 lines. Another line added to the lateral diameter will represent the typical form.

Localities. Minchinhampton Common; Bisley Common.

CYPRINA JURENSIS, Goldf., sp. Tab. XIII, fig. 3.

VENUS JURENSIS, Goldfuss. Petref., p. 245, t. 150, fig. 17.

Testá parvâ suborbiculari; umbonibus medianis minutis; lunulâ ovatâ; areâ lanceolatâ.

Shell small, smooth, nearly orbicular, rather depressed; umbones mesial and small; lunule ovate; area lanceolate.

The nucleus figured by Goldfuss from the Coral Rag of Nattheim, agrees in form with our little species, and they are probably identical.

Height, $5\frac{1}{2}$ lines; lateral diameter, 7 lines.

Localities. Bisley Common, at Eastcombs, and Bussage.

CYPRINA DEPRESSIUSCULA. Tab. XIII, fig. 4.

Testá suborbiculari, lævi, convexo-planá; umbonibus medianis parvis acutis; lunulá subexcavatá; margine postico curvato; basi arcuatá.

Shell suborbicular, smooth, and slightly convex; umbones mesial, small, and pointed; lunule slightly excavated; hinge margin curved; base regularly rounded.

The smooth, rather depressed surface, the mesial pointed umbones, and absence of all angularity in the outline, are the leading characters of this shell, which appears to be rare. Its position is the soft shelly Oolite, about the middle of the shelly beds.

Height, 8 lines; lateral diameter, $9\frac{1}{2}$ lines.

Locality. Minchinhampton Common.

CYPRINA NUCIFORMIS, *Lycett*. Tab. XII, fig. 4.

CYPRINA NUCIFORMIS, *Lycett*. Journ. Geol. Soc., 1853, vol. 9, p. 340, pl. 14, fig. 3.

Testá subnuciformi, convexá; umbonibus magnis curvatis; marginibus rotundis; latere postico angulo obtuso obliquo; lunulá excavatá.

Shell subcordiform or nut-shaped, convex; umbones large, prominent, and curved forwards; margins of the valves rounded; posterior side with an oblique, obtuse angle; lunule large, slightly excavated.

A very convex species, with large umbones, less oblique and more convex than *Venus trapeziformis*, Roemer.

Height and length equal; convexity of the valves one third less.

Localities and position. In Gloucestershire it occurs in the middle portion of the Inferior Oolite; our specimens are from the Great Oolite of Ponton, in Lincolnshire.

Genus—TANCREIDIA. *Lycett*, 1850.

TANCREIDIA, *Lycett*. Ann. Nat. Hist., 1850, p. 407.

HETTANGIA, *Terquem*, 1852. *Buvignier*. Statistique Géologique, Minéralogique et Paléontologique du Département de la Meuse; Atlas, p. 14.

— *Terquem*, Bull. Soc. Géol. de France, 10. p. 368.

Gen. Char. Shell equivalve, subæquilateral, smooth, somewhat flattened, transverse, donaciform; umbones nearly mesial, small, contiguous, flattened; anterior extremity usually pointed; no lunule; posterior side more convex, with an oblique angle more or less conspicuous, the extremity truncated, and more or less gaping; ligament short, external, placed in a small depression; basal margin lengthened, curved, or elliptical;

hinge with an obtuse cardinal tooth in each valve, which is received into a corresponding cavity in the other valve; occasionally in the right valve there is a small anterior, and in the left a small posterior accessory tooth or prominence upon the margin of the cavity; lateral teeth are large, posterior, and approximate in each valve, that of the left valve projecting and received into a depression of the tooth or callosity of the other valve. Muscular impressions oval; pallial impressions simple, faintly marked. There is no lunule; the margin of the right valve anterior to the umbo forms a thickened projecting fold, which covers the tooth of the other valve, and is received into a corresponding receding portion of the margin of that valve; so that the junction of the valves anterior to the umbo has a sinuous flexure.

In the typical species, *T. donaciformis*, which is an Inferior Oolite shell, the lateral teeth are remarkably large; and they are nearly equally conspicuous in the *Hettangia Deshayesea*, Terquem, and *H. Broliensis*, from the Lias of the Moselle and the Meuse, figured by M. Buvignier; but the other Liassic species described by that author, coincide in their dental characters more nearly with our Great Oolite species of this genus. In these, the shells are more delicate, the hinges are smaller and more elongated, the teeth are less projecting, and the cardinal tooth of the left valve is elongated forwards, somewhat upon the anterior border; the lateral teeth are variable in their prominence, and not uncommonly the tooth of the right valve is indistinct or obsolete. When the valves are much flattened, the posterior aperture becomes narrow or not distinguishable. The figure of *Tancredia* varies according as the anterior or posterior sides are the most produced; but more commonly the posterior side is the shorter one, and when it is much truncated, the figure then nearly resembles that of the recent *Donaces*. All the species at present known are destitute of ornament; they are smooth, and exhibit but indistinctly the lines of growth. The margins of the valves are smooth, and, independently of the posterior aperture, there is a general irregularity in the form of the margins, so that they are not close fitting along their extent. In England, *Tancredia* has only hitherto been noticed in the lower Oolitic rocks. M. Buvignier and M. Terquem have recognised eleven species in the Lias of France, and Dr. Dunker one from Halberstadt. To the geologist a knowledge of this form is of importance, as the species appear to be very limited in their vertical range, and hitherto it has not been discovered that any one of them is common to two formations. The profuseness with which *T. brevis* is distributed in the shelly beds of the Minchinhampton Great Oolite, and the young of *T. donaciformis* in the shelly freestone of the Leckhampton Inferior Oolite, is such, that each becomes the most abundant bivalve of their respective localities; the valves are always disunited, and casts are unknown.

In looking to the affinities of this genus, we discover a near approximation—almost an actual passage—into a group of Oolitic forms, which are as yet very imperfectly known, and of which *Corbis laevis*, Sow., and *Corbis depressa*, Buvig., are examples. Three other species have been obtained from the Inferior Oolite of the Cotteswolds, and one from the Coralline Oolite of Malton. In all of these a smooth surface is coincident with a

compressed, elongated figure, and a hinge, the dentition of which differs materially from that of the better known forms of *Corbis*. The shells, likewise, are rather thin, the margins not toothed, and the posterior side is always the larger of the two.

TANCREEDIA TRUNCATA, *Lycett*. Tab. XIII, fig. 11.

TANCREEDIA TRUNCATA, *Lycett*. Ann. and Mag. Nat. Hist., 1850, pl. 11, f. 10.

Testá subtrigóná, ovato-cuneatá; umbonibus posticis; latere postico, brevi, truncato; antico elongato, margine superiore ejusdem recto, obliquè-declivi; margine inferiore subrecto.

Shell subtrigonal, or ovately wedge-shaped; umbones posterior; posterior side short, truncated; anterior side elongated, its superior margin straight, sloping obliquely downwards, the extremity rounded; basal margin nearly straight.

The short posterior side slopes suddenly downwards, it is bounded by an obscure angle or ridge.

Height, $6\frac{1}{2}$ lines; length, 13 lines; diameter through both the valves, 5 lines. Its position is the shelly beds of the Great Oolite, in which it is somewhat rare.

Localities. Minchinhampton and Bisley Commons.

TANCREEDIA BREVIS. Tab. XIII, fig. 8.

Testá parvâ subtrigónâ; umbonibus submedianis; latere postico brevi, angulo producto; marginibus acuminatis, margine inferiore elliptico.

Shell small, subtrigonal; umbones submesial, depressed; posterior side sloping obliquely, and having a prominent angle, which passes obliquely from the umbo to the postero-inferior border; margin of the valves pointed at both extremities, the inferior margin curved elliptically.

Compared with *T. axiniformis* this species is much more short and convex, and it always forms a prominent angle upon the posterior side, posterior to which the surface is flattened, or even slightly excavated, the extremities of the valves being pointed. In its geological range it accompanies the two other species; it is everywhere common, and certain layers of soft shelly Oolite beneath the planking of Minchinhampton Common are entirely covered with its valves; undoubtedly it is the most abundant bivalve in the district.

Length, $7\frac{1}{2}$ lines; height, $4\frac{1}{2}$ lines.

The *Tancredia donaciformis*, *Lycett*, 'Ann. and Mag. Nat. Hist.,' 1850, vol. vi, pl. xi, fig. 8, approximates so nearly to our species that it is necessary to discriminate between the two forms. The *T. donaciformis* is more lengthened, the umbones are mesial, but the anterior side is more attenuated, its marginal slope being slightly concave, and its extremity more pointed, so that the posterior side appears to be larger than the other; it occurs in the shelly free stone of the Inferior Oolite, Leckhampton Hill, in an abundance rivalling our Great Oolite species.

Locality. The whole of the Minchinhampton district.

TANCREIDIA CURTANSATA, *Phil.*, sp. Tab. XIII, fig. 7a, b.

CORBULA CURTANSATA, *Phil.* Geol. York., 1, t. 3, f. 27.

Testá ovato-elongatá; umbonibus medianis, parvis; antice compressá, acuminatá, postice convexá; margine antico obliquè declivi concavo; basi ellipticá curvatá.

Shell ovately elongated; umbones small, mesial; anterior side compressed, its extremity pointed; posterior side moderately convex, its margin slightly rounded; antero-superior border obliquely sloping and concave; base elliptically curved.

This is the largest of the Great Oolite species of this genus, it is moderately abundant in the shelly beds; specimens vary much in the convexity of the valves.

Height, 10 lines; length, 15 lines; diameter through the valves, 7 lines.

Localities. Minchinhampton, in the Great Oolite; Malton, in the Coralline Oolite.

TANCREIDIA AXINIFORMIS, *Phil.*, sp. Tab. XIII, fig. 6a, b.

NUCULA AXINIFORMIS, *Phillips.* Geol. York., 1, t. 11, f. 13.

TANCREIDIA EXTENSA, *Lycett.* Ann. and Mag. Nat. Hist., 1850, pl. 2, f. 9.

— AXINIFORMIS, *Morris.* Journ. Geol. Soc., 1853, v. 9, p. 341, pl. 14, f. 4.

Testá ovato-trigoná elongatá, convexo planá; umbonibus medianis; latere postico convexiore, angulo oblique subacuto; margine anteriore et posteriore rectis, obliquè declivibus; basi ellipticá curvatá.

Shell ovately trigonal, elongated, rather depressed, pointed at the extremities; umbones mesial, depressed, small, and pointed; the posterior side the more convex, with a subacute oblique angle separating a space posterior to it, which is slightly concave; anterior and posterior margins straight, and sloping obliquely downwards; lower margin curved elliptically.

Specimens of this species present a considerable amount of variability in their figure; those from Lincolnshire are usually more convex posteriorly, and have the angle more acute, the space posterior to it being somewhat concave; the Minchinhampton specimens are flatter, the umbones scarcely so much elevated, the posterior angle more obtuse, the space adjoining it being flattened. These differences at first induced us to regard the two as distinct species, and the first description of *T. extensa*, published in the 'Annals of Nat. Hist.' for 1850, was deduced from Gloucestershire specimens, as compared with the acute angle and otherwise distinct figure given in the 'Geology of Yorkshire;' but an examination of numerous specimens, and more especially of those from Lincolnshire, have satisfied us that at the utmost, those of the North of England can only be considered as a variety of the more common form seen in Gloucestershire.

Tancredia angulata is a higher shell, with a shorter posterior, and more attenuated anterior side.

Length, 11 lines; height, 6 lines.

Geological position and localities. *T. axiniformis* occurs in the Inferior Oolite of Yorkshire, and in the Great Oolite of Ponton, Lincolnshire, and of Minchinhampton, in the shelly beds.

TANCREEDIA PLANATA. Tab. XIII, fig. 10*a*, *b*.

Testá ovatá, planatá; umbonibus submedianis parvis acuminatis; antice compressá; postice plano-convexá; margine postico obliquè-curvato; antico recto obliquè declivi; basi curvatá.

Shell ovate, flattened; umbones nearly mesial, small, and acute; anterior side compressed, its extremity rounded; posterior side rather more convex; the posterior margin has an oblique curvature; the anterior margin is straight, and slopes obliquely; the base is curved elliptically.

A delicate, smooth, and flattened shell, the anterior extremity of which is much less acuminate, and the posterior less truncated than is usual in this genus. It is moderately abundant in the shelly beds of the formation, and varies considerably both in its outline and degree of convexity.

Height, 9 lines; length, 13 lines.

Localities. Minchinhampton and Bisley Commons.

TANCREEDIA ANGULATA, *Lycett*. Tab. XIII, fig. 9*a*, *b*.

TANCREEDIA ANGULATA, *Lycett*. Journ. Geol. Soc., 1853, vol. 9, p. 341, pl. 14, f. 5.

Testá ovato-trigoná; umbonibus elatis, medianis, acutis; latere antico compresso; postico angulum obliquum formante; margine cardinali brevi, recto horizontali; basi curvatá.

Shell ovately subtrigonal; umbones elevated, mesial, acute; anterior side compressed; posterior side with an oblique angle separating a flattened posterior portion; ligamental margin short, horizontal; basal margin with a considerable curvature.

This species, which is smaller than *T. curtansata*, is distinguished from that form by the flattened and angulated posterior side, and by the more erect and acute umbones; and from the Inferior Oolite *T. donaciformis*, by the more erect, acute umbones, and more lengthened form; the basal margin has also a more considerable curvature.

Height, 9 lines; length, 14 lines.

Geological position and localities. Ponton, Lincolnshire, and Minchinhampton; at both places in the Great Oolite.

CORBIS. Sub-genus—CORBICELLA.

Testá inornatá, ovato-elongatá, subcompressá; umbonibus plerumque antemedianis depressis, contiguis; margine superiore elongato, subrecto, obliquo; ligamento externo

brevi ; basi ellipticâ curvatâ. Cardo dentibus cardinalibus duobus subtrigonis, et laminâ testaceâ posticâ, elongatâ, cum dente laterali postico remoto obtuso in utraqve valvâ. Impressiones musculares ut in Corbis ; valvium marginibus interni integri.

Shell destitute of ornament, ovately elongated, rather compressed ; umbones contiguous and depressed, and placed a little anterior to the middle of the valves ; superior or ligamental border lengthened, nearly straight, and sloping obliquely ; ligament external, short, and contained in a groove ; basal margin curved elliptically. Hinge with two cardinal sub-trigonal teeth, a lengthened posterior lamina, and a remote, obtuse, posterior lateral tooth in each valve. Muscular impressions as in *Corbis*, the anterior impression being small and oval, the posterior larger and more rounded, the inner margins of the valves plain. Casts of a large Inferior Oolite species exhibit an oblique anterior sulcation, which passes downwards immediately behind the anterior impression, and is obliterated towards the lower border ; this sulcus indicates the presence of an oblique rib upon the interior of each of the valves. The character of the hinge is shown in Tab. XII. fig. 13, 13a.

This group of shells, of which the Great Oolite contains a small species, consists of six or more Oolitic species, which all agree in their characteristic features ; their external aspect is sufficiently distinct from the typical group of *Corbis*, their surface is destitute of ornament, and the greater development of the posterior side indicates a distinction, which is confirmed by an examination of the hinge characters. The anterior lateral tooth is always absent, and the internal ridge, which in the typical form of *Corbis* descends from it anterior to the impression, passes in our group posterior to the impression, as is clearly shown by the groove in the cast. The stratigraphical position of the known species of this group is as follows. The Inferior Oolite of the Cotteswolds has two species ; our Great Oolite shell is the third ; a large elongated shell in the Coralline Oolite of Malton is the fourth ; the *Corbis depressa*, Desh., from the department of the Meuse, is the fifth ; and another, probably, is the *Psammobia Moreana*, Buvig., 'Pal. de la Meuse' Atlas, pl. iv, figs. 8—10 ; the latter form nearly resembling our Great Oolite species. The number of these species, and their general accordance in form, surface, and hinge characters, indicate a distinctness worthy of consideration. M. Buvignier, in his description of *Corbis depressa*, Desh., 'Pal. de la Meuse,' p. 12, has, we believe, correctly indicated the natural affinities of this group ; he regards it as establishing a passage between *Corbis* and *Hettangia* (Tancredia). Adopting this view, we would likewise place it intermediate to *Corbis* and the latter genus.

CORBIS (CORBICELLA) BATHONICA. Tab. XIII, fig. 14.

Testâ ovato-elongatâ subcompressâ tenui ; umbonibus antemedianis ; latere antico rotundo, postico elongato, subtruncato, angulo obliquo obtuso ; basi curvatâ ; lateribus plicis incrementi paucis, irregularibus.

Shell ovately elongated, rather compressed, the test thin ; umbones small, anterior to

the middle of the valves; anterior side rounded, posterior side elongated, the superior border being nearly straight, and sloping obliquely, the posterior extremity is rather truncated; an obscure and obtuse angle descends obliquely upon the posterior side; the sides of the shell have a few irregular folds of growth; the base is curved elliptically.

A delicate species, which varies considerably in its figure, and in the distinctness of its lines of growth; the dental characters are minute, and can rarely be exposed. It is nearly allied to a much larger and more stout Inferior Oolite species, in which the figure is usually more elongated, and the dental characters much more conspicuous. The relative dimensions in this shell vary so much that measurements have little value, but the umbones are always anterior to the middle of the valves. It occurs rather commonly throughout the shelly beds of the formation.

Locality. Minchinhampton.

QUENSTEDTIA.

Testá æquivalvi, subæquilaterá, oblongá et planatá; umbonibus parvis, contiguis, compressis; ligamento externo; foveá ligamenti angustá et elongatá; margine antico rotundo, postico compresso, subquadrato; superficie plicis longitudinalibus plus minusve instructá. Cardo dente cardinali unicá obtusá et transversá in valvâ sinistrâ, valva dextra fossâ cardinali unicá transversá sub umbone sitâ. Impressiones musculares postici rotundi, antici elongati et sinuati; impressio pallealis sinu brevi.

Shell equivalve, subequilateral, oblong, and flattened; umbones small, contiguous, and compressed; ligament external, placed in a narrow elongated groove; anterior margin rounder; posterior margin compressed and subquadrate; the surface with irregular longitudinal plications more or less conspicuous. Hinge with one obtuse transverse cardinal tooth in the left valve, which is received into a corresponding pit in the opposite valve. Posterior muscular impressions rounded; anterior impression elongated and sinuated; siphonal scar with a small sinus. (Tab. XV, fig. 12. Tab. IX, fig. 4a. b.)

A genus approximated to Psammobia in the general figure of the valves, but distinguished from it in the position of the ligament, which is placed in a narrow fossa, instead of upon the raised nymphal plate of Psammobia; the single transverse tooth is another distinctive feature, and reminds us of Myoconcha; the sinus in the siphonal scar is much smaller than in Psammobia or Sanguinolaria.

QUENSTEDTIA OBLITA, var. Tab. IX, fig. 4, 4a, b., and Tab. XV, fig. 12.

Syn. PULLASTRA OBLITA, Phillips. Geol. York., 1, tab. 11, fig. 15.

Testá ovato-oblongá compressá; umbonibus parvis medianis; antice rotundatá, postice compressá, subtruncatá, angulo obliquo declivi obtuso; latere postico plicis longitudinalibus irregularibus.

Shell ovately oblong, compressed; umbones small, mesial, compressed, rather pointed; shell with the sides anteriorly rounded, posteriorly compressed, truncated, and forming an obtuse angle, which slopes obliquely downwards to the infero-posterior extremity; the posterior side has some irregular longitudinal plications, which disappear towards the middle of the shell.

The Great Oolite variety of this species is many times smaller than that of the Inferior Oolite, and it is rather more elongated, but it presents no real specific difference. The test is delicate.

This shell was referred to Pullastra, by Professor Phillips, from its external form only, and we believe that only one or two specimens were at his disposal. The figure in the 'Geology of Yorkshire,' unaccompanied by any description, appears to have misled Professor Quenstedt, who has figured the hinge of *Tancredia donaciformis*, Lyc., for his exemplification of *Q. oblita*. The *Panopæa Lebrunæa*, Buvig. 'Paléont. de la Meuse,' Atlas, pl. 7, fig. 6, 7, is nearly allied to our species, but is more elongated and less truncated posteriorly. The arrangement of the longitudinal ridges is very similar.

Localities and position. *Quenstedtia oblita* has occurred in the Inferior Oolite of Blue Wick, Yorkshire, and in the upper portion of the same formation at Rodborough Hill, Cotteswold. The shelly Great Oolite of Minchinhampton Common has afforded our smaller variety; but the species appears to be rare at each locality.

Dimensions. Our largest Inferior Oolite specimen has a length of $2\frac{1}{2}$ inches, and is $1\frac{3}{8}$ inch in height, the greater number of specimens being about 2 inches in length; but the Great Oolite variety is only 6 lines in length, and 3 in height.

CORBULA, Brug. 1791.

Shell ovately trigonal, convex, inequivalve, the left valve being the smaller; a single cardinal tooth in each valve projecting, that of the left valve being compressed; there is likewise a pit in each valve contiguous to the tooth, which is destined to receive the ligament; the ligament is internal, inserted in the pit of the right valve, and in the cavity of the tooth of the left valve; depression of the mantle posteriorly angulated.

CORBULA INVOLUTA, Goldf. Tab. IX, fig. 6.

CORBULA INVOLUTA, Goldfuss. Petref., t. 151, f. 14.

„ STRIATA, Buckman. Geol. of Cheltenham, 2d edit. p. 97, pl. 3, f. 4.

Testá parvâ convexâ, concentrice striatâ; umbonibus submedianis; latere postico rostrato, carinato, excavato; latere antico rotundato.

Shell small, convex, concentrically striated; umbones nearly mesial; posterior side rostrated and slightly excavated; anterior side rounded.

An acute angle passes from the umbo obliquely backwards, separating a narrow area from the remainder of the surface; the concentric striæ are continued upon the flattened posterior area. This little shell is one of the most abundant in the formation; its concentric striæ are very frequently not preserved, and the valves are never found in opposition. The test is thick, and the characters of the hinge strongly marked.

Height, 3 lines; lateral diameter, 4 lines.

Localities. Minchinhampton Common, and Eyeford, Gloucestershire.

NEÆRA IBBETSONI. Tab. XII, fig. 9.

NEÆRA IBBETSONI, *Morris*. Geol. Soc. Journ., 1853, p. 341, pl. 14, fig. 6.

Testâ subglobosâ, pyriformi, subæquivalvi, striatâ; umbonibus magnis submedianis; latere antico rotundo; postico producto, bicarinato, subrostrato; basi curvato; lateribus plicis regularibus inconspicuis; nucleo lævi.

Shell subglobose, pyriform, subequivalve, striated; umbones large, rounded, mesial; anterior side rounded; posterior side produced, attenuated, and bicarinated, the anterior carina acute; lower margin curved; the sides with regular, slightly marked plications; nucleus smooth.

A very convex and nearly equivalve shell, with an acutely marked angle upon the posterior attenuated slope; anterior side rounded. The nucleus has the posterior extremity compressed, short, and truncated. It ranks as one of the most rare productions of the Lincolnshire beds.

Height, 9 lines; length, 11 lines; diameter through both the valves, 8 lines.

Localities. Danes Hill; Essendine, and Ketton quarries. Dedicated to Capt. L. B. Ibbetson, F.R.S., in whose company it was first noticed, much compressed in the clays above the Ketton Oolite.

Family—MYADÆ.

Previously to stating our views upon this extensive family, we desire to record our obligations to Agassiz, for his important work, 'Etudes Critiques,' which exhibits a large amount of patient research, of critical sagacity, and original views. The author has, however, candidly admitted that his work is imperfect in certain of the details—that facts are sometimes wanting or insufficiently known, and consequently that the genera proposed by him are probably not all of equal value. The subject, indeed, is connected with difficulties of more than one kind, and of such a nature, that subsequent observers might be expected to differ in their estimates of the value of the several generic distinctions proposed by M. Agassiz, and might even determine to discard some of them altogether. The length of time which has elapsed since the publication of the 'Etudes Critiques' has been sufficient for the accumulation of many additional facts tending to render our theoretical

views more precise and conclusive. The considerable opportunities afforded us for investigation, and the interest with which we have long viewed this obscure family, combine to impart to our language a degree of confidence which we should not otherwise venture to express. The numerous and varied series of these fossil forms all agree in having their test of great tenuity and delicacy, so that not unfrequently we are reduced to derive our knowledge from an examination of their internal casts; or, should the tests be preserved, it is very rarely that we are enabled to expose sufficiently their hinges or other internal characters. In this family we also lose another important aid in the determination of the genera, inasmuch as the dental characters of the hinge are reduced almost to nothing, the Oolitic Myadæ being altogether destitute of hinge teeth, properly so called, and possessing only a shelly lamina, variously modified in form, and extending internally posteriorly to the umbones, and supporting the cushion of the ligament; but this lamina never forms an elevated nymphal collosity, as in certain recent genera.

At the period of the publication of the 'Etudes Critiques,' the internal hinge characters of certain of the genera had not been fully ascertained. They were known only from appearances upon the external moulds or internal casts; and in more than one instance the author was induced to rely upon the observations of others, although these were opposed to his own experience. These uncertainties have since gradually been diminished, not, indeed, without the perpetration of other errors, and it will be found that in the present Monograph, we have been induced to adopt certain modifications of, and other changes in, several of the genera, although our exemplifications of the Myadæ constitute only a subordinate position in the testacea of the Great Oolite.

In discriminating the fossil Myadæ, it will be found that certain features, which are only of subordinate importance in shells of the symmetrical acephala, generally become the principal, and, indeed, sole aids upon which we have to rely; fortunately, however, these features, which are included in the terms *general figure and ornaments of the surface*, acquire in the Myadæ an increased degree of importance from their invariable persistence and distinctness of design, in a similar ratio that the hinges and their characters have degenerated in value.

The thin flexible coverings of the fossil Myadæ have a much more intimate relation to the forms of the enclosed Mollusks than is possessed by the shells of other families of bivalves; the shell does not form a mere compact rigid cyst, but rather a thin sheath or tegument, which conforms to the figure of the Mollusk itself, and varies somewhat according to the circumstances in which the animal was placed with relation to the surrounding ground, or to contiguous organisms. The entire family have large, irregular, longitudinal folds or ridges, which are, for the most part, but imperfectly distinguishable upon the internal casts. The genera of Myadæ, proposed by Agassiz, are the following. Pholadomya, Homomya, Corimya, Ceromya, Cercomya, Goniomya, Myopsis, Pleuromya, Arcomya, Platymya, and Mactromya. Pholadomya had previously been established, and remains uncontroverted.

Corimya is the *Thracia* of Leach, the latter author having the priority; *Tellina incerta*, Thurm., is an English Oolitic example.

Mactromya has, we believe, justly been dismembered by D'Orbigny, the forms which Agassiz regarded as typical having been separated from the *Myadæ* to constitute the genus *Unicardium* of the former author, and has been previously described in this Monograph. Three remaining species, referred by Agassiz to *Mactromya*, are too imperfectly known to justify us in pronouncing their true position with any confidence.

Ceromya may now be considered as sufficiently established; the hinge characters, which were imperfectly known to Agassiz, have been fully described by M. Buvignier, 'Bull. Geol. Soc. Fr.,' 1850; for, although the shell upon which the latter author founded his description is a *Gresslya*, we have ascertained that the hinges of the two genera are altogether alike. M. d'Orbigny ('Prodrome de Paléontologie') and M. Buvignier ('Paléont. Dep. de la Meuse') have merged *Gresslya* in *Ceromya*, but we consider that Agassiz was justified in regarding them as distinct, their figures are essentially different; the *Ceromyæ* are all ventricose, with incurved equal subspiral umbones; they are equivalve, for although there is much irregularity in this respect, and occasional inequality of the valves, these variations are altogether accidental, and resulted probably from the position which the Mollusk occupied in the ground, or its proximity to other bodies; their surface has regular ridges which are not altogether smooth, they are concentric, or in other species they take an oblique direction; or, again, they suddenly change their direction and are reflected after the manner of the *Goniomyæ*. *Gresslya*, on the contrary, is never perfectly equivalve, the right valve being always larger, and its umbo higher than the other; the form is much more compressed, the umbones more pointed, the surface is destitute of the peculiar ridges of *Ceromya*, but possesses a different kind of ornamentation; the outer layer consists of a very delicate pellucid semicorneous test, with densely arranged radiating lines of granules, the lines usually slightly undulate, and the granules, which are regular, are densely arranged, and so minute as scarcely to be visible to the unassisted eye. M. Agassiz was not acquainted with this fact, which we have ascertained by an examination of a large number of examples in a good state of preservation. *Cercomya* has been shown by M. d'Orbigny to be identical with *Anatina*, of which it possessed the usual vertical fissure beneath the umbones and the granulated surface; but the aspect of the two forms differs in other particulars, for Oolitic species are compressed, the posterior side is remarkably elongated, and the anterior side has large longitudinal ridges. These features indicate a distinction which we regard as of subgeneric value. We would, therefore, place *Cercomya* as a sub-genus of *Anatina*.

Goniomya is a form which we believe to be entitled to a separate generic rank, notwithstanding M. d'Orbigny and M. Buvignier have reunited it to *Pholadomya*; the ridges upon the sides are strongly impressed upon the internal casts, and are very different from the costæ of *Pholadomya*; and it has, moreover, a granulated surface, the granules, as in *Gresslya*, being radiating and linear.

There yet remain a very numerous and varied series of the fossil Myadæ, which have been separated by Agassiz under the names of *Myopsis*, *Pleuromya*, *Arcomya*, *Platymya*, and *Homomya*. These forms are found in the Muschelkalk, and throughout all the Secondary rocks; one or more species likewise occur in the older Tertiary rocks of England. M. Agassiz believed that *Myopsis* was distinguished from the others by the presence of a tooth in the hinge (*vide* D'Orbigny), although he had never been able to detect its presence, and also by its possessing a surface ornamented by radiating lines of granules. We have been enabled to ascertain that the most abundant of the British Myopsides (*Mya dilata*, Phil.) is destitute of any cardinal tooth, and that the granulated surface, which M. Agassiz relied upon as distinguishing *Myopsis*, is possessed also in a manner more or less modified by *Arcomya*, *Platymya*, *Pleuromya*, and *Homomya*.

There remains, therefore, between these proposed genera little more than the distinction of figure; and even this feature, although sufficiently remarkable and distinct in certain selected typical species, approximates so nearly in others, that in very many instances it is only possible to separate them as distinct groups by an arbitrary and uncertain arrangement. The test of these shells is very thin, and a depression more or less distinct exists upon the anterior side of the valves, extending from the umbones to the inferior border.

The Myopsides are usually elongated posteriorly; their siphonal aperture is large, and their radiating lines of granules are distantly arranged, and large upon the posterior side: *Mya dilata*, Phil., is a well-known English example. *Arcomya* is more rhomboidal or subquadrate; the anterior side is compressed; the posterior has an oblique prominence the siphonal aperture is elongated and narrow. *Pleuromya*, with more tumid umbones, has its superior border slightly concave, and the posterior third of the shell is attenuated with a small aperture. *Platymya* resembles *Myopsis*, except that the umbones are placed nearer to the middle of the valves; the figure is more compressed, and the siphonal aperture is small. *Homomya* resembles the more elongated of the Pholadomyas. The umbones are large and usually but little compressed; but, with this exception, there is nothing to distinguish the figure from one or other of the preceding types, insomuch that M. Agassiz, in the absence of a knowledge of the test, was sometimes unable to allocate them to either of his proposed genera. Certain of the shells which Agassiz would refer to *Homomya* possess a feature which tends to approximate them to the true Pholadomyas, viz., the presence of a few faintly marked radiating costæ upon the umbones. These, however, are uncertain, and sometimes vanish altogether. Such species appear to form a true passage, connecting the more elongated Pholadomyas with the Panopæas. The granulated surface which distinguishes this great series of fossil Myadæ presents several modifications of character, and tends to separate more fully the several species. The first modification has the granules rather large, placed upon lines which are slightly elevated and distantly arranged: some of the larger Myopsides and *Arcomyæ* present examples. The second modification has the lines of granules distinct; but the granules are minute, and both these and the rows are very closely arranged: the *Pleuromyæ* have usually this

kind of surface. The third modification has the entire surface covered with granules so minute as to be nearly or altogether invisible to the unassisted eye. They are so dense that the linear arrangement cannot be recognised: the *Homomyæ* have this kind of surface. In the present state of our knowledge, it would not appear that the figure of the shell affords any certain guide to the character of the granules which adorn its surface, a general resemblance of form being sometimes coincident with a very different kind of surface, and in the fossil *Myadæ*, wherein the figures of the individuals present much variability, and consist more commonly only of casts, the presence of a small portion of the outer granulated tegument will in some instances serve as a sure guide to distinguish species for which the casts alone would not have sufficed. It is owing to the absence of the test that so many of the figures of the 'Etudes Critiques' of Agassiz afford only doubtful guides to the correct knowledge of the species.

The foregoing observations will prepare the reader for the conclusion at which we have arrived, viz., that *Myopsis*, *Pleuromya*, *Arcomya*, *Platymya*, and *Homomya* cannot claim to be regarded as distinct genera, and that it is very difficult, or perhaps not practically possible, even to separate them into so many sections or sub-genera. They seem rather to constitute a single very extensive and varied series of forms, which, although individually resembling in certain of their features either *Pholadomya* or *Panopæa*, are nevertheless sufficiently separated from both of these genera, and possess a generic entirety which is rather strengthened than otherwise by these resemblances.

The hinge exactly resembles that of *Pholadomya*, except that the subligamental lamina is more stout, and the test at that part of the shell is generally more thickened. It is therefore destitute of the sharp tooth of *Panopæa*; but even this feature is not without exceptions, for M. Buvignier has figured an Oolitic species, which has a distinct tooth, and we have ourselves discovered a tooth slightly defined in an Inferior Oolite shell, other examples of which present no trace of this feature.

The hinge then generally resembles that of *Pholadomya*, and some few species or rather individuals of these species, by possessing a few delicate radiating costæ upon the umbones, present another feature which tends to approximate them to the same genus. To *Panopæa* other examples are allied by the occasional presence of a projecting cardinal tooth, and by a universal flattening or depression upon the anterior third of the valves. The granulated surface, however, removes it equally from *Panopæa* and *Pholadomya*. In the figure of the muscular impressions we recognise a close resemblance to those of *Pholadomya*, the anterior impression being very narrow, pyriform, and so much elongated upwards as to reach nearly to the umbo. In *Panopæa* the figure of this impression is irregular and different. The siphonal flexure is always very great, whatever may be the figure of the posterior side of the shell. Briefly to recapitulate these analogies and differences: our group is allied to *Pholadomya*, in the features of the hinge and of the muscular impressions, but differs from it in the absence of costæ, in the presence of radiating lines of granules upon the surface, and in the vertical depressions upon the sides of the shell. It

resembles *Panopæa* in the depression upon the middle or anterior side, and by the presence of an occasional cardinal tooth in the hinge; but these affinities are neutralized by the differing figure of the anterior muscular impression, by the usually edentulous hinge, and by the granulated surface. We regard, therefore, *Myacites* (*Schlot.*) as a genus intermediate and connecting *Pholadomya* with *Panopæa*.

The genus *Myacites*, *Schlotheim*, was founded upon certain *Muschelkalk* shells, which belong to our great group of granulated *Myadæ*, and have that kind of figure which belongs to the *Pleuromyæ* and perhaps to the *Homomyæ* of Agassiz. *Schlotheim*, who had no knowledge either of the hinge or of the test, characterised his genus in the following terms:

“*Testa transversa, inæquilatera, subhians, obovata vel ovalis, ventricosa lævis, concentrice striata; umbones anteriores.*”

The meagreness and insufficiency of this description would render the genus valueless, in the absence of other and more precise knowledge; but as the *Muschelkalk* shells are well known, *Schlotheim* has a claim to priority in the generic designation, and as the five genera proposed by Agassiz must necessarily be referred to the same group, those of the latter author must be discarded as superfluous. Our arrangement of the fossil *Myadæ* will be as follows:

Pholadomya.

Anatina, Sub-gen. <i>Cercomya</i>	.	.	.	.	.	Genus, <i>Cercomya</i> , <i>Ag.</i>
<i>Goniomya</i>	.	.	.	.	.	„ <i>Goniomya</i> , <i>Ag.</i>
<i>Ceromya</i>	.	.	.	.	.	„ <i>Ceromya</i> , <i>Ag.</i>
<i>Gresslya</i>	.	.	.	.	.	„ <i>Gresslya</i> , <i>Ag.</i>
<i>Thracia</i>	.	.	.	.	.	„ <i>Corimya</i> , <i>Ag.</i>
<i>Myacites</i>	.	.	.	.	.	<i>Myopsis</i> , <i>Pleuromya</i> , <i>Platymya</i> , <i>Arcomya</i> , and <i>Homomya</i> , <i>Ag.</i>

GRESSLYA, Ag.

Shell ovate, rather compressed, very inequilateral, sub-equivalve; umbones anterior, contiguous, compressed, acute, and incurved; lunule excavated; anterior side convex, its border rounded; posterior side more attenuated, sometimes rostrated; superior border rather convex, sloping obliquely downwards; lower margin curved elliptically, borders of the valves close, or with a very small posterior aperture; ligament external, short; hinge line externally somewhat sinuous; the shell is not perfectly equivalve, the umbo of the right valve being a little higher in the other; the test is extremely delicate, with fine longitudinal plications, and with very densely arranged radiating rows of minute granules. Hinge edentulous, but having an elongated lamina in each valve, that of the left valve being inserted beneath the outer lamina of the other valve, as in a groove; there is also in the right valve an oblique internal rib, which extends posteriorly, and is only visible

upon the casts, a feature similar to that in *Ceromya*; the muscular impressions are very faintly marked, as is likewise the pallial impression, the flexure of which appears to be short. This genus, having been reunited to *Ceromya* by M. d'Orbigny, and M. Buvignier having figured and described the hinge of a *Gresslya*, named by him *Ceromya Deshayesi*, in a very complete manner, it has become necessary to institute a close comparison between the two generic forms, and to weigh carefully their affinities and differences.

1stly. *Form.* *Ceromya* is usually larger than *Gresslya*, and always more ventricose, the umbones are more prominent, those of *Ceromya* approaching to the form of *Isocardia*; *Gresslya*, with its acute umbones and more compressed figure, approaches to that of *Cardinia*: *Gresslya* is also very constantly slightly inæquivalve, the right valve exceeding the other in height; in *Ceromya* they are equal, and any irregularity of form which may sometimes occur to give the semblance of inequality in the valves is altogether accidental, and depends, apparently, upon the portion of the shell during its growth.

2dly. *Character of the Surface.* The sculptured surface of *Ceromya* is quite unlike that of any other of the *Myadæ*, the longitudinal grooves being more or less visible upon the casts, but the casts of *Gresslya* are smooth, and the granulated surface of the test is altogether different from that of *Ceromya*.

3dly. *Hinge Characters.* In *Ceromya*, as in *Gresslya*, the casts of the right valve exhibit a groove posterior to the umbones which has been impressed by a corresponding prominence or internal rib in that valve; in *Ceromya*, however, this groove is likewise visible upon the exterior of the test, but not in *Gresslya*; the internal hinge laminæ are precisely alike in both genera; but this is a feature which in the fossil *Myadæ* has but little value in generic affinity or distinction. Whatever value the Palæontologist may be disposed to attach to the foregoing distinctions when viewed singly, it must, we think, be admitted that in the aggregate they are of considerable importance, and it is necessary to neglect none of them in forming a fair estimate of the two forms.

Gresslya was eminently gregarious, *Ceromya* not so, and for the most part it occurs much more sparingly; both lived in the same beds; the valves of *Ceromya* are frequently disunited, in *Gresslya* they are invariably in contact.

GRESSLYA CARDITÆFORMIS.

Testâ ovato-depressâ; umbonibus prominentibus subplanis, latere antico producto rotundato, basi curvatâ, latere postico abrupte declivi, lineis incrementi paucis, irregularibus.

Shell ovate, depressed; umbones prominent, rather compressed; anterior side produced and rounded; base curved; posterior side sloping abruptly; lines of growth few and distant.

This species possesses a general resemblance to *Gresslya Saussuri*, the *Venus Saussuri* of Brongniart and Goldfuss, but our shell has much less convexity; in both species the outline has a considerable resemblance to that of a *Venus*, but an examination of the hinge border has proved that it is edentulous.

The extreme tenuity of the test will account for its uniformly bad state of preservation and rareness. It occurs in a bed of soft shelly Oolite, which is situated about the middle of the shelly beds, and abounds with valves of *Tancredia*.

Length, $2\frac{1}{4}$ inches; height, $1\frac{3}{4}$ inches; diameter through both the valves, 7 lines.

Locality. Minchinhampton Common.

GRESSLYA PEREGRINA, var. ROSTRATA. Tab. X, fig. 7.

GRESSLYA ROSTRATA, Agassiz. Etud. Crit., t. 12 b, fig. 7, 8.

Testá ovato cuneiformi, antice rotundatá, postice elongatá et acuminatá, basi subrectá.

Shell ovate or somewhat cuneiform, rounded anteriorly, produced and pointed posteriorly; basal margin nearly straight.

The posterior side is somewhat compressed, forming an angle which extends obliquely from the umbones to the infero-posterior extremity, and there forms a pointed termination.

Height, 13 lines; lateral diameter, 19 lines; diameter through both the valves, 10 lines.

Locality. The southern side of Minchinhampton common, where small openings in the Stonesfield slate have afforded a few of the internal moulds. The genus never occurs in the shelly beds of the formation. Marls of the *Ostrea acuminata* (fuller's earth).

CEROMYA, Ag.

Shell cordiform or oval, very inequilateral, ventricose; umbones large, contiguous, incurved, involute; lunule excavated; anterior side convex, its border rounded; posterior side elongated and more flattened, its border either closed or having a slight aperture; ligament narrow, external. The surface is ornamented with one or more series of ridges and sulcations, which are longitudinal but not always concentric. In certain species a change in the direction of the ridges occurred at a certain period of the growth; substance of the test thin, almost papyraceous. Hinge edentulous; a lengthened lamina beneath the ligament in the left valve is received into a groove beneath the lamina of the opposite valve; there is also in the right valve an obliquely elongated posterior rib or internal depression, which, unlike that of *Gresslya*, is visible upon the surface of the test; muscular and pallial impressions rarely distinguishable; the anterior impression is pyriform, elongated upwards, and jagged or fringed irregularly, as in *Pholadomya* and *Gresslya*.

The variety of figure in *Ceromya* is very considerable; *Ceromya similis*, Lyc., in its elongated and compressed form approaching to that of *Gresslya*; the opposite figure is exemplified by *C. Bajociana*, D'Orbigny, which has the short ventricose aspect of *Isocardia*, between these there is every gradation of figure. *Ceromya* occurs rarely in the shelly beds of the Great Oolite, the valves being most commonly disunited, the tests are then preserved; in other situations without shelly detritus the valves are united, but the tests have disappeared.

CEROMYA SYMONDSII. Tab. X, fig. 4a, b.

Testá ovato-ventricosá, umbonibus magnis obliquis incurvis, latero antico convexo, postico subcompresso et elongato, basi curvato; plicis concentricis regularibus tenuibus non nunquam obsoletis.

Shell ovately ventricose; umbones large, oblique, incurved; anterior side convex; posterior side rather compressed and elongated; base curved; concentric plications regular, very delicate, not unfrequently indistinct.

The general figure approaches *C. concentrica*, but it is more elongated, the umbones being more oblique and anterior; the concentric plications are more delicate, and are curved with a larger ellipse, they become undistinguishable near to the umbones. The substance of the test is extremely delicate, so that the fine plications are frequently visible upon the nucleus. The height of the shell is rather greater than the diameter through both the valves, and one fifth less than the longitudinal diameter, a slight aperture exists at the posterior extremity of the valves.

Localities. Nuclei occur rather commonly in the upper portion of the Great Oolite two miles east of Minchinhampton, but examples with the test preserved are very rare in the shelly beds of Minchinhampton Common; it also occurs in the Inferior Oolite of the same district.

The name in compliment to the Rev. W. S. Symonds, the Founder and President of the Malvern Naturalist's Field Club.

CEROMYA UNDULATA. Tab. IX, fig. 1, 1a, b.

Testá ovato-oblongá, tumidá; umbonibus anticis elongatis sub-terminalibus, involutis; latere antico angusto, brevissimo; postico lato, elongato; margine superiore convexo, interdum subundulato cariná dorsali oblique instructo; margine postico truncato; inferiore subrecto; lateribus lineis obliquis, excentricis crebris regularibus tenuissimis et undulatis; basi et margine postico plicis concentricis paucis irregularibus.

Shell ovately oblong, tumid; umbones anterior, elongated, subterminal, and involute; anterior side narrow, very short; posterior side much wider and elongated; superior margin convex but irregular, sometimes rather undulated, a keel or angle passes obliquely from the umbones posteriorly nearly parallel to the superior border; the posterior margin is truncated, the lower margin straight. The sides of the shell are covered with densely arranged undulating fine lines, which are directed obliquely or excentrically from the umbones towards the wide posterior border, but do not reach it, being decussated by a few irregular concentric plications, which in advanced growth occupy the inferior and posterior margins of the valves; the supero-posterior angle separates the sides from a narrow posterior surface which is destitute of the excentric lines.

The tenuity of the test is extreme, and the fine radiating lines are usually visible upon the internal casts. The figure varies even more than is usual in the *Ceromyæ*. It has some resemblance to *Ceromya inflata*, Agassiz, but in that shell the character of the plications and their direction is altogether different, the size, likewise, never attains to that of our species.

In the greater number of specimens there is a wide depression, which extends from the region of the umbones to the inferior border, giving a compressed aspect to the anterior and inferior portion of the shell.

It occurs not unfrequently in the upper beds of the Great Oolite in beds of buff-coloured hard sandstone, situated about 95 feet above the fuller's earth, but always in the form of casts; in the shelly beds of the formation it occurs very rarely, the test is then preserved, and the valves disunited.

The form of *Ceromya undulata* presents the greatest possible contrast to *Gresslya*, but it is not easy to describe the distinctive features however striking.

Height, 17 lines; length, 20 lines; diameter through both the valves, 16 lines.

Locality. Minchinhampton.

CEROMYA PLICATA, Ag., var. Tab. X, fig. 1a, b, fig. 2.

CEROMYA PLICATA, Ag. Etud. Cret. Myes., tab. 8 d, 1842.

CARDITA V-COSTATA, Buckman. Geol. Chelt., 2d edit., p. 97, 1845.

Testá ovato-oblongá, inflatá; umbonibus anticis depressis, involutis; latere antico brevissimo, tumido, truncato; latere postico lato, aperturá ejusdem magná et elongatá; margine superiore elato; inferiore subrecto et subundulato; lateribus fastigiis longitudinalibus crebris, subundulatis, superne acutangulo reflectis, (ælate progrediente) aliis concentricis decussatis; lateribus semel in medio sulcis radiantibus obscuris notatis.

Shell ovately oblong, much inflated about the middle of the valves; umbones involute, anterior and depressed; anterior side very short, truncated and tumid; posterior side wide, its aperture large and lengthened; superior margin much elevated, and rather compressed; inferior margin lengthened, nearly straight, and sometimes slightly undulated; the sides of the valves with closely arranged longitudinal ridges, which slightly undulate, and towards the superior and posterior border are suddenly reflected anteriorly, forming acute angles; in progress of growth these reflected ridges are nearly effaced, and a second series of concentric ridges are formed, which cross the others obliquely towards the inferior border; lastly, in adult specimens, there may be distinguished a few obscure radiating sulcations about the middle of the valves. This shell, in the young condition, is a pretty species; the longitudinal ridges are very distinct, and their V-like angle towards the superior border is clearly defined; in adult shells the figure is more ventricose, the superior angle formed by the ridges is nearly effaced; the second, or concentric series of ridges, are formed, and some few radiating sulcations may be traced.

Collectors have very generally mistaken this species for *Ceromya excentrica*, a shell which is stated to occur abundantly in the upper or Portlandian Oolite of Switzerland, at Porrentroy, and in a similar parallel in the Jura of Soleure; *C. plicata* has not heretofore been adequately figured or described; the specimens figured by M. Agassiz represent adult and even aged shells, not well preserved, and in which the V-like angle of the ridges has nearly disappeared; his description is likewise more than usually meagre, and, in the absence of other evidence, the reader would be inclined to believe that the author had unnecessarily separated this shell from *C. excentrica*, but an examination of specimens in several stages of growth has convinced us of the propriety of the specific distinctions which are given in the 'Etudes Critiques;' the general figure is near to *C. excentrica*, except that in the adult forms the superior border is more compressed and elevated, and the posterior aperture is much larger; the change in the direction of the ridges upon the surface is not peculiar to *C. excentrica*, but occurs in other species of the same genus, neither is it a regular and constant feature in any species, or rather, we should say, that it is never found in the young condition of any species. All the specimens known are casts, the delicate and very perfect markings in young examples is a sufficient indication that the test must have been of extreme tenuity, and the partial obliteration of these features with advance of growth, evidences a corresponding change in the character of the test. In the specimen figured by Agassiz the angles of the reflected ridges are less acute.

Dimensions. Our largest specimen is in length $3\frac{1}{4}$ inches; in height, $2\frac{1}{2}$ inches; the diameter through both the valves being $2\frac{1}{4}$ inches.

Localities and position. We have observed this species in the upper beds of the Inferior Oolite in Gloucestershire in the fuller's earth it has occurred over the Sapperton tunnel of the railway, from which deposit a specimen has kindly been forwarded to us by John Wilson, Esq., of Gloucester; we have ourselves obtained it from certain hard limestone beds near to the base of the Great Oolite in the Minchinhampton district, and Professor Buckman has recorded a specimen which he obtained in a bed of clay at Sevenhampton, which appears to be a little higher in the series; it is, however, rare at each of these localities.

CEROMYA CONCENTRICA, Sow., sp. Tab. X, fig. 3a, b.

ISOCARDIA CONCENTRICA, Sow. Min. Con., tab. 491, fig. 1.

— — *Phil.* Geol. York., 1, pl. 11, fig. 40.

— — *Morris.* Catal. Brit. Foss., 1st. Ed. p. 88. 1843.

Testá ventricosá, ovato-obliquá, umbonibus magnis incurvis subanticis, latere antico convexo, postico subcompresso, basi curvato, lateribus fastigiis tenuibus concentricis regularibus crebris.

Shell ventricose, ovately oblong; umbones large, incurved, anterior to the middle of

the valves; anterior side convex; posterior side more elongated and compressed; base curved; the sides of the shell with regular closely arranged concentric and fine ridges.

The umbones are prominent and elevated, more especially by comparison with *C. Symondsii* and *C. Northamptoniensis*, the two contemporaneous forms which most nearly approach to it; owing to this prominence, the superior border is rendered slightly concave. The valves fit closely, except at the posterior extremity, which has a slight aperture. The test is never preserved. It is liable to be confounded with a larger and magnificent Inferior Oolite species, which occurs in the neighbourhood of Stroud, and has the test preserved; this latter, which we believe to be the *Ceromya Bajociana* of D'Orbigny, 'Prodrome de Paléontologie,' p. 275, and, probably, the *Isocardia concentrica* of Phillips; in this shell the umbones are very large, and curve gracefully forwards; they are more median and less oblique; the general form is more ventricose, and the posterior side is shorter than in the true *Ceromya concentrica*.

Ceromya concentrica does not occur in the shelly beds of the Great Oolite, it occurs in the upper portion of the formation associated with *C. Symondsii* in the Minchinhampton district, and also near to Nymphsfield, it is also abundant in the Marl bed of the Inferior Oolite, and in the upper division of the same formation.

Dimensions of a Great Oolite specimen. Height, 16 lines; length, 20 lines; diameter through both the valves, 14 lines.

Localities. The neighbourhood to the east of Minchinhampton, and at Nymphsfield, in the Great Oolite; the escarpment of the Cotswolds generally in the Inferior Oolite.

CEROMYA SIMILIS. Tab. XII, fig. 12.

CEROMYA SIMILIS, *Lycett*. Geol. Soc. Journ., 1853, p. 340, pl. 14, fig. 2.

Testá ovato-oblongá, convexá; umbonibus anticis incurvis; latere antico brevissimo, convexo, postico elongato mediocriter attenuato; margine superiori et inferiori parallelis, subrectis; striis concentricis magnis regularibus et crebris.

Shell oblong, elongated, convex; umbones anterior, incurved, anterior side convex, very short, its margin rounded; posterior side elongated, superior and inferior borders nearly parallel, horizontal, and slightly curved; the lunule is excavated; the sides of the valves have regular, strongly impressed, and closely arranged longitudinal striations, which nearly vanish as they approach the superior border.

The form of this elegant species is intermediate between *Ceromya concentrica* and *C. excentrica*, some examples approaching more nearly to the former, others to the latter shell, the striations are strongly marked, rather larger than in *C. concentrica*, and there exists a slight vertical depression upon the middle of the valves; the umbones are rather depressed, scarcely rising higher than the elongated superior border.

Height, 15 lines; length, 22 lines; diameter through both the valves, 14 lines.

Locality. Ponton, in the shelly beds; also in the lower strata of Stamford, Morcot, &c.

THRACIA, *Leach.*CORIMYA, *Agassiz.*

Shell subtrigonal, inequivalve, inequilateral, rather flattened; cardinal area distinctly marked, the hinge margin forming a sudden declivity posterior to the umbones; the area is separated from the sides by a carina more or less visible; the left valve is always smaller than the right, its umbo is flatter or less elevated; the surface has concentric plications more or less prominent; the substance of the test is extremely thin, more especially in the smaller valve; the valves do not gape, or but very slightly, and the hinge is destitute of teeth. From *Tellina* it is distinguished by the absence of teeth, and by its wanting the lateral flexion which distinguishes that genus.

THRACIA STUDERI. *Ag. sp.*

TELLINA INCERTA, *Thurm.*, Roemer, Verst. Nordd. Ool., p. 121, tab. 8, fig. 7.

— — — *Goldf.* Petref., tab. 146, fig. 14.

CORIMYA STUDERI, *Ag.* Etud. Crit., p. 267, tab. 35.

Testá subæquivalvi obovatá, convexá-planá, antice convexá; margine curvato; latere postico abrupte compresso; umbonibus medianis inæqualibus, compressis; lateribus plicis concentricis irregularibus.

Shell subequivalve obovate, moderately convex, anterior side convex, its margin curved, posterior side compressed, attenuated, and separated from the other portion of the shell by an obtuse angle (sometimes imperfectly defined). The umbones are mesial and contiguous, but not prominent nor large, the margins of the valves are close fitting; the sides of the valves have numerous irregular concentric plications.

This species is more elongated, and has the posterior side more produced than our other Great Oolite species; the Cornbrash specimens have considerable variety of figure, with respect to their height and to the distinctness of the posterior angle, irrespective of accidental compression.

Geological position and localities. In England it occurs in the Cornbrash of Wilts, and in the Great Oolite of Northamptonshire. M. Agassiz states that it is abundant in the Portlandian beds of Porrentruy, Jura. Goldfuss records it in the upper oolite of Hanover.

THRACIA CURTANSATA. Tab. XIII, fig. 1a, b.

Testá convexo-planá, subtrigoná, subæquilateralí, et lævigatá; umbonibus submedianis, inæqualibus incurvis; latere postico abbreviato; valvâ sinistrâ subplaná, umbone parvo; plicis concentricis tenuissimis irregularibus.

Shell depressed but convex, subtrigonal, nearly equilateral and smooth; umbones nearly mesial, unequal, and incurved; posterior side short; left valve compressed, its umbo small; surface with concentric, closely arranged, very fine, and irregular plications.

The surface is very smooth, the posterior side is scarcely so much attenuated as is usual in this genus, and the cardinal area is very obscurely defined. The general figure approaches the *Corimya tenuistriata* of Agassiz, but that shell has a smaller longitudinal diameter, and the umbones are not so nearly mesial. It would appear to be very rare, but has occurred both in the lower or shelly, and upper portions of the Great Oolite.

Locality. Minchinhampton.

MYACITES, *Schlot.*

Syn. MYOPSIS, *Ag.* PLEUROMYA, *Ag.* ARCOMYA, *Ag.*

PLATYMA, *Ag.* HOMOMYA, *Ag.*

PANOPÆA, sp. *Buvignier.* PANOPÆA, sp. *D'Orbigny.*

Shell elongated, umbones anterior to the middle of the valves, contiguous, depressed, anterior border rounded, posterior border either rounded or truncated, both extremities gaping, sometimes equally so, or the posterior aperture is the more expanded, and sometimes slightly reflected; a depression more or less distinct extends from the umbones to the inferior border; ligament external and short; test delicate, with irregular longitudinal plications, and ornamented with a pellucid outer tegument, having granules disposed in radiating lines. Hinge without teeth, with an elongated horizontal thickened plate, which extends posteriorly to the umbones, and supports the ligament; muscular impressions usually indistinct, but resembling those of *Pholadomya*, pallial impression with a very large posterior flexure.

Under the comprehensive term *Myacites*, we arrange a very extensive series of forms which have been referred to *Amphidesma*, *Lutraria*, *Sanguinolaria*, *Myopsis*, *Arcomya*, *Pleuromya*, *Homomya*, and *Platymya*; commencing in the *Muschelkalk*, their numbers increased in the *Lias*, and they continued to hold a very prominent position throughout the oolitic and lower portion of the Cretaceous rocks.

From others of the *Myadæ* which have granulated surfaces, as *Gresslya*, *Goniomya*, and *Anatina*, they are distinguished by features which will be found under those genera.

We regard *Myacites* as a form which connects *Panopæa* with *Pholadomya*, by means of the more elongated forms of the latter species, and more especially by the hinge, which differs from *Pholadomya* solely by the greater thickness and strength of the former.

MYACITES VEZELAYI. *Lajoye*, Sp. Tab. XI, fig. 5, 5a.

Syn.

MYA VEZELAYI, *D'Archiac.* Mem. Soc. Geol. Fr., vol. v, tab. 24, fig. 4.

HOMOMYA GIBBOSA, *Ag.* Etud. Cret. Myes., pl. 18.

Testá nucleo elongato, umbonibus parvis anticis depressis, latere antico brevissimo, compresso, postico ventricosso, aperturá ejusdem valde elongatá, margine superiore concavo, inferiore curvato; lateribus plicis longitudinalibus magnis et irregularibus.

Shell with the nucleus elongated, ventricose about the middle portion, and compressed towards the two extremities; umbones anterior, rather small, and depressed; posterior aperture of moderate breadth, but very much lengthened upon the superior margin, which is concave; the inferior margin is curved and nearly parallel to the superior, it has a narrow antero-basal aperture. The sides of the valves have large irregular longitudinal plications, and near to the umbones are some traces of a few radiating lines or costæ.

The aspect of this species is so much compressed from above, and tumid laterally, that the diameter through both the valves exceeds the height of the shell, and exceeds half its length; there is a superficial depression which extends downwards obliquely to the middle of the lower border, and coincides with the extent of the basal hiatus; the figure altogether is more ventricose and depressed than any other example of *Homomya* hitherto figured. M. Agassiz appears to have mistaken this species for *H. gibbosa*, the *Lutraria gibbosa* of the 'Min. Con.,' tab. 42 and 211; but the latter shell differs from it very considerably in figure, it is less depressed, has much larger umbones, is less ventricose in its middle portion, is destitute of the flattening of the anterior side, and likewise of the large longitudinal plications of *H. Vezelayi*.

We are not aware that the test of *M. Vezelayi* has ever been found preserved, the prominence of the plication indicates that it was very thin; we have not seen any traces of the muscular or palæal impressions.

Localities and position. It is abundant in the clays of the fuller's earth throughout the Cotteswolds, and we have obtained several specimens a little higher in beds of hard sandstone, near to the base of the Great Oolite, on the southern side of Minchinhampton common, associated with several other of the *Myadæ*.

MYACITES CRASSIUSCULUS. Tab. IX, fig. 3.

Testá crassá, ovato-elongatá, antice et postice subcompressá, in medio ventricosá, umbonibus anticis subcompressis, latere antico brevi, margine rotundo; latere postico elongato, aperturá angustá, sed elongatá; margine superiori et inferiori subrectis et parallelis; lateribus plicis longitudinalibus crebris irregularibus; areá ligamenti magná, latá.

Shell thick, ovately elongated, umbones anterior, moderately large, and compressed laterally; anterior side short and compressed, its margin rounded; posterior side elongated and attenuated, its aperture narrow and elongated upwards, the middle portion of the shell obliquely ventricose; superior and inferior borders parallel, nearly straight and horizontal; the cardinal area is large and distinctly circumscribed; the surface has closely arranged irregular longitudinal plications. The internal surface of the left valve has a curved projecting rib placed a little anterior to and beneath the umbo.

From *Macra gibbosa*, Sow., this species is distinguished by the less elevated and compressed umbones, by the more straight and horizontal superior and inferior borders, and more especially by the very marked depression of the anterior side, which in *M. gibbosa* is convex. The test upon the anterior side and near to the umbones has a considerable degree of thickness; the rib of the left valve deeply indents the cast. The surface of the test, although identical in character with that of other species of *Myacites*, has never exhibited any distinct portion of granulated surface; had the granules been large, they could scarcely have failed to have been preserved equally with the surfaces of other species in the same bed. Indications of a few radiating lines, near to the umbones, are sometimes obscurely visible upon the test.

Dimensions of a small Great Oolite specimen. Height, $1\frac{1}{4}$ inch, length, $2\frac{1}{2}$ inches, diameter through both the valves, 1 inch; but the examples from the Inferior Oolite of the Cotteswolds are not uncommonly more than double these dimensions.

Geological position and localities. Ponton, Lincolnshire, in the Great Oolite; Rodboro'-hill, near Stroud, in the gryphite grit of the Inferior Oolite; at the latter locality the test is preserved; it also occurs not uncommonly in the form of casts throughout the Cotteswolds, in the same stratum; but it has usually been confounded with *Macra gibbosa*, Sow., a shell whose test is rarely preserved, and which does not occur so low as the gryphite grit.

MYACITES CALCEIFORMIS, *Phil.* sp. Tab. XI, fig. 2.

MYA MARGARITIFERA, *Young and Bird.* Geol. York. Coast, pl. 7, fig. 2.

MYA CALCEIFORMIS, *Phil.* Geol. York., 1, t. 11, fig. 3.

Testá elongatá, compressá, antice subconvexá, postice compressá et attenuatá, costá unicá obscurá ab umbone ad basin instructá, lateribus plicis longitudinalibus irregularibus, testá delicatissima, granulis radiantibus crebris minutis.

Shell elongated, somewhat compressed; umbones acute, anterior to the middle of the valves; anterior side rather convex, its margin rounded, and the aperture narrow; posterior side compressed, lengthened, and somewhat pointed, its aperture small; superior margin sloping obliquely, nearly straight; inferior margin nearly straight; a single obscure elevation extends from the umbo to the inferior border, and there is, occasionally, posterior to it, a wide superficial depression; the longitudinal plications are numerous, fine, and irregular; the test is of extreme tenuity, and covered with lines of very minute radiating granules.

Specimens are usually destitute of the delicate test, but well preserved portions of it are occasionally found. It is nearly allied to *Myopsis marginata*, Ag., 'Etud. Crit. Moll.,' tab. 30, fig. 1, 2, but the species of Agassiz has a shorter anterior side, less rounded, and the convexity of the valves is more considerable; it is also higher and shorter than the

Panopæa longa, Buvig., 'Géol. de la Meuse, Atlas,' pl. 7, fig. 1, 3, to which, in other respects, it has a general resemblance.

The *Arcomya calceiformis*, Ag., 'Etud. Crit. Myes.,' p. 176, tab. 9, fig. 7, 9, from the ferruginous Oolite of Moutiers, is a different species of the same group or sub-genus, and must be distinguished from our shell, which has the priority of name.

Height, 21 lines; length, 43 lines; diameter through both the valves, 14 lines.

Position and localities. The geological range of this species is considerable; in the Cotteswolds it occurs in the upper beds of the Inferior Oolite, in the fullers' earth, also in hard pale coloured sandstone near to the base of the Great Oolite; it occurs also in the Cornbrash of Chippenham, Malmesbury, and Cirencester; and at the latter three localities it is not uncommon. Professor Phillips records it in the Inferior Oolite of Blue Wick, and in the Kelloway rock of Scarborough.

MYACITES DILATUS, *Phil.* sp. Tab. X, fig. 5 *a, b*.

MYA DILATA, *Phil.* Geol. York., 1, tab. 11, fig. 4.

— — *Morris.* Catal. Brit. Foss., p. 92.

SANGUINOLARIA (?) DILATA, *Buckman and Strickland.* Geol. Chelt., pl. 6, fig. 1.

PANOPEA DILATATA, *D'Orb.* Prodr. de Paleont., 10 etag. No. 216.

Testá elongatá, anticè compressá, posticè subcylindricá, dilatá et truncatá; umbonibus antemedianis, parvis, compressis; aperturá anticá angustá; posticá magná superne elongatá; margine superiori concavo, inferiore subrecto; lateribus plicis irregularibus magnis, angulo postico flecto; superficie granulis regularibus serialibus radiantibus dispositis.

Shell elongated, anterior side compressed, posterior side nearly cylindrical, dilated and truncated at the extremity; umbones anterior to the middle of the valves, small, and compressed; anterior aperture narrow; posterior aperture large, suborbicular, but extending along the superior border almost to the ligament; superior border concave; inferior border nearly straight; the sides of the shell with a few large irregular longitudinal plications, which are bent upwards posteriorly at a considerable angle; the radiating lines of granules are rather large, and most conspicuous upon the posterior side.

The compressed anterior side of the shell is strikingly contrasted with the posterior expansion. Much variation exists in the proportions of its posterior elongation, and the latter border is sometimes reflected, the more aged specimens being the most elongated: the figure in the 'Geology of Cheltenham' represents the most shortened phase of form. The Great Oolite specimens are small; they have not occurred in the shelly beds, but in some imperfectly slaty deposits near to the base of the formation. The species also occurs in the fullers' earth, and in the upper portion of the Inferior Oolite, the latter rock producing by much the finer specimens. The punctations upon the granules appear to resemble those of the recent *Anatina hispidula*, and in like manner probably gave in-

section to as many corneous prickles; but we have not been able to trace this feature in all specimens.

The species most nearly allied are *Sanguinolaria? rotunda*, 'Geol. Chelt.,' pl. 6, fig. 3, and *Panopæa Guibaliana*, Buvignier, 'Géol. de la Meuse,' Atlas, pl. 8, fig. 3—5, but it is more trumpet-shaped and less elongated than the former, and less compressed than the latter.

Localities. Small excavations on the southern slope of Minchinhampton Common, in the Great Oolite; also in the Cotteswolds generally in the fullers' earth and Inferior Oolite; Glaizedale, Yorkshire.

MYACITES TERQUEMEA, *Buv. sp.* Tab. XII, fig. 6.

Syn. PLEUROMYA TENUISTRIA, *Ag.*, 1848, pl. 24.

PANOPÆA TENUISTRIA, *D'Orb.*, 1850, Prod., 1, etag. 10, No. 242, (non *Buv.*)

Non LUTRARIA TENUISTRIATA, *Munst. in Goldf.*, pl. 153, fig. 2.

PANOPÆA TERQUEMEA, *Buvig.* Paleont. Dep. de la Meuse, Atlas, p. 7.

Testá obovatá, ventricosá; umbonibus subacutis, antemedianis, latere antico cordato-declivi, subdepresso, postice attenuato, aperturá parvá; plicis longitudinalibus tenuibus.

Shell obovate, ventricose mesially; umbones rather acute, anterior to the middle of the valves; anterior side rather compressed, its border rounded; posterior side attenuated, its border slightly gaping; lower margin curved; longitudinal plications delicate.

The greatest diameter through the valves is a little anterior to the umbones, which gives a somewhat ventricose aspect to the figure.

Length, 16 lines; height, 10 lines; diameter through both the valves, 8 lines.

Geological position and localities. Our specimens are from the shelly beds of Minchinhampton Common, where it is very rare. Agassiz and Goldfuss have recorded it in the lower Oolitic rocks of France and Germany.

MYACITES UNIONIFORMIS. Tab. X, fig. 6.

Testá tumidá, ovato-elongatá; umbonibus magnis, subcompressis; margine antico et postico rotundo; margine superiori concavo, lateribus lævigatis; sulco lato superficiali ab umbone ad marginem inferiorem producto.

Shell tumid, ovately elongated; anterior side short; posterior side elongated; both anterior and posterior margins rounded; the posterior margin gapes but slightly; the hinge margin is elongated and concave; the area is lengthened, lanceolate, or narrow, and distinctly marked; the ventral margin is somewhat rounded; a wide, superficial depression extends from the umbo obliquely to the inferior border, and renders the anterior side nearly as much compressed as the posterior; the surface is smooth with faintly-marked irregular concentric plications.

The species which approach nearly to the present form, are the *Homomya gracilis* Agassiz, 'Etud. Crit.,' p. 162, tab. 20, f. 1—2, and *Mya Vezelayi* of D'Archiac, 'Mém. Soc. Geol. Fr.,' tom. 5, pl. 25, fig. 4; but compared with the former shell, the figure is more compressed laterally and less elongated: the concavity of the superior border and larger umbones are other points of distinction. The species described by D'Archiac is very much more ventricose, and the umbones are more nearly terminal; the posterior aperture is likewise much more considerable.

Besides these there is another large undescribed species found in the upper division of the Inferior Oolite of the Cotteswolds, which resembles more nearly the present species than either of those before mentioned; but it is of thrice the linear dimensions, somewhat more elongated, and the superior border is not concave; the test and ligament, which are very well preserved, enable us to affirm its distinctness both from the Great Oolite species, and from *Homomya gracilis*, to which perhaps it is still more nearly allied. We possess two specimens, which occurred in the bed of soft shelly Oolite which overlies the Weatherstones: it would, therefore, appear to be very rare.

Height, 13 lines; longitudinal diameter, 26 lines; diameter through both the valves, 12 lines.

Locality. Minchinhampton Common.

MYACITES COMPRESSUS. Tab. XII, fig. 11.

Testá ovato-rhomboideá; umbonibus prominentibus compressis; latere antico brevi, compresso, margine ejusdem subrecto declivi; latere posteriore medocre elongato, convexo, margine truncato; margine cardinali, subrecto, oblique, declivi; margine inferiore sinuato; lateribus sulco lato superficiali ab umbone margine inferiore producto.

Shell ovately rhomboidal; umbones prominent and compressed; anterior side short, its margin nearly straight, sloping obliquely, and somewhat rostrated at the inferior extremity; posterior side moderately elongated, convex, its margin truncated; hinge border nearly straight, but sloping obliquely downwards; inferior margin sinuated; the sides with a wide and superficial depression directed from the umbones to the inferior margin.

The general contour of this species is remarkable for the anterior compression of the valves and of the umbones, which are prominent and very oblique; the height of the valves is so considerable, that it equals two thirds of the length. The straight anterior slope distinguishes it from *Arcomya Couloni*, Agassiz, which in other respects it nearly resembles. From our *M. tumidus* it is separated by the greater height of the valves and oblique slope of the hinge margin, which is also shorter; the anterior side is likewise more compressed, and its margin straighter. The granulated surface is not preserved in our specimen.

Height, 21 lines; length, 33 lines; diameter through both the valves, 16 lines.

Locality. Minchinhampton Common.

MYACITES TUMIDUS. Tab. IX, fig. 2 a, b.

Testá subrhomboidéa, valvis in medio tumidá, latere antico brevi, compressiusculá; posticè elongato et truncato; margine ventrali subrecto et sinuosá; margine cardinali subrecto et horizontali; valvis lævigatis ligamentum magnum; lateribus lineis incremente confertis et irregularibus.

Shell subrhomboidal, its middle portion tumid; anterior side short and compressed; posterior side elongated and somewhat truncated; ventral margin nearly straight and somewhat sinuous; hinge margin straight and almost horizontal; the valves smooth; ligament large; series of growth numerous and irregular.

An obtuse and very tumid surface extends obliquely from the umbones to the inferior and posterior border, which renders that part of the shell more convex than is usual in this genus. The anterior border slopes obliquely, but is somewhat rounded, and is moderately compressed. There can scarcely be said to be a hiatus at the anterior border, and the posterior border, which is somewhat truncated, has only a narrow opening. The entire form is short, as much so as *Arcomya brevis* of Agassiz. The shortness, together with the greater convexity of the middle portion of the valves, serves to distinguish it from *Arcomya quadrata* of the same author. This species of *Myacites* is represented by one specimen only: it has the ligament preserved, which is prominent, but not much lengthened.

Height, 16 lines; length laterally, 27 lines; greatest diameter through both the valves, 15 lines.

Locality. Minchinhampton Common.

ANATINA, Lam. CERCOMYA, Agassiz.

Shell elongated; umbones mesial, small, and depressed; anterior side rounded and produced; posterior side attenuated, having a lengthened and strongly defined posterior area, which has two longitudinal furrows upon its surface; no lunule. The surfaces of the valves are covered with large longitudinal ridges, which are strongly marked anteriorly, but are faintly traced posteriorly. There exists two depressions, more or less marked, upon the side of the shell, which, originating at the umbo, diverge obliquely, and are directed to the inferior border, causing that margin to undulate. These depressions, although superficial, influence the direction of the longitudinal folds, make them to deviate from their normal direction, and sometimes efface them altogether. The extremities of the valves gape, more especially at the posterior extremity.

M. Agassiz, judging from the contorted figure of the casts and the absence of anything like a fracture, thinks that the test must have possessed considerable flexibility.

M. d'Orbigny regards this group as identical with *Anatina*. He believes that the furrows upon the area are impressed by carinæ, which were destined to support the spoon-shaped processes of the hinge, and states that he has observed a chink or cleft at the summit of the umbo, left by the spoon-shaped processes and by the internal osselet of *Anatina*.

M. Agassiz admits that these features would indicate an affinity with *Anatina*, but directs attention to the elongated posterior side, to the cardinal area, and to the large longitudinal ridges upon the sides of the valves. These characters, which are wanting in *Anatina*, have induced him to retain his genus *Cercomya*.

One character of the genus has not been alluded to by M. Agassiz. It possesses an external semicorneous layer of test, which is furnished with radiating lines of tubercles, as in *Goniomya*, *Myacites*, *Gresslya*, and in the recent *Anatina*.

Anatina has not been found in the shelly beds of the Great Oolite. It occurs in beds near to the base of the formation, in pale argillaceous buff-coloured limestones and sandstone; it has also been found in the upper portion of the formation, associated with *Goniomya*.

M. Agassiz has sufficiently indicated the features which distinguish externally *Cercomya* from *Anatina*. The interiors of the valves of the fossil species have not been seen, but there is every reason to believe that they do not differ from *Anatina*.

ANATINA PlicateLLA. Tab. XI, fig. 6, 6 a.

Testâ transverse-elongatâ, convexiusculâ, latere postico elongato; plicis concentricis crebris inconspicuis, postice obsoletis.

Shell transversely elongated, convex; anterior side rather short, its upper border sloping obliquely from the umbo; posterior side more lengthened. Lateral longitudinal plications closely arranged, distinct upon the anterior side of the shell, but disappearing as they recede from it, so that the greater portion of the surface is nearly smooth. The very delicate plications and general convexity of the valves are sufficient to distinguish it from contemporaneous species.

Height, 13 lines; length, 25 lines; diameter through both the valves, 9 lines.

The figure nearly resembles that of *C. antica*, Agassiz, tab. 11a, fig. 14, 15; but the plications of that species are much larger and more continuous upon the sides.

Locality. It occurs very rarely in Stonesfield Slate, on the south side of Minchinhampton Common.

ANATINA UNDULATA, Sow. sp. Tab. XI, fig. 4.

SANGUINOLARIA UNDULATA, Sow. Min. Con., t. 548, f. 1, 2.

— — *Phil.* Geol. York., 1, t. 5, f. 1.

Testá elongatá, convexá; umbonibus medianis, areá magná, marginibus depressis, lateribus plicis longitudinalibus magnis, striis longitudinalibus densè impressis.

Shell elongated convex; umbones mesial, area large, its margins faintly marked, the sides with very large regular plications, which are impressed with very fine densely arranged longitudinal striæ.

The length of the posterior side slightly exceeds the other; its extremity is slightly curved upwards, it is rarely preserved or perfectly represented upon the internal moulds; the lines of radiating tubercles cannot be distinguished upon the moulds. Height 9 lines; lateral diameter, 22 lines; diameter through both the valves, 8 lines.

Locality. Minchinhampton.

GONIOMYA, Ag.

Shell very thin, cylindrical and ventricose, or ovate and flattened, gaping at both the extremities, more especially the posterior extremity; anterior extremity rounded, posterior truncated; umbones mesial or a little anterior to the middle of the valves, contiguous and not very prominent; costæ large and curved, their anterior portions are directed obliquely backwards towards the inferior border, the posterior portions are directed in a similar manner forwards, so that the extremities of the costæ meet each other near to the middle of the shell at an angle more or less acute. The costæ are crossed and indented by closely-arranged concentric plications. The substance of the test has two layers, of which the outer one is semi-corneous, and is furnished with minute tubercles which are arranged in lines radiating from the umbones. Hinge edentulous; muscular impressions faintly marked; ligament external.

GONIOMYA LITTERATA, Sow. sp. Tab. XI, fig. 3.

GONIOMYA LITTERATA, Agassiz. Etud. Crit., p. 18, t. 16, f. 13-16.

MYA LITTERATA, Sow. Min. Con., t. 224, fig. 1.

LYSIANASSA LITTERATA, Goldf. Petref., t. 154, f. 8.

Testá ovato-elongatá, convexá; umbonibus ante-medianis, margine cardinali subhorizontali aut concavá, margine antico obliquè declivi; costis anticis angustis subundatis; posticis magnis curvatis ultimis evanescentibus; plicis concentricis crebris decussatis; angulo costarum acuto, obliquo margine postico producto; margine inferiore subrecto.

Shell ovately elongated, convex, umbones placed anterior to the middle of the valves, superior margin elongated, nearly horizontal, or even slightly concave, anterior margin sloping obliquely, inferior margin nearly straight; costæ anteriorly narrow, nearly straight, and slightly undulated, posterior costæ larger, curved but become obscure towards the extremity of the series; the costæ are decussated with closely arranged regular concentric plications; costal angle acute, and directed obliquely towards the infero-posterior border.

Our specimens agree more nearly with the figures of Agassiz than with those of Goldfuss; in the latter, the posterior side is not so much raised, so that the hinge margin slopes downwards in a manner similar to that of the anterior border, and the costal angle is not directed obliquely backwards; so that, judging from the figure alone, it might be regarded as a distinct species. Compared with *Goniomya v.—scripta*, our shell has much less prominent umbones, and the entire figure of the shell is more elongated or sub-cylindrical, the umbones being likewise more anterior; the posterior side of the shell is more lengthened, its superior margin being nearly horizontal. It is comparatively rare; we have obtained it in thin layers of pale or buff-coloured argillaceous limestone, about 100 feet above the fullers' earth, also in a much lower position, in a similar description of rock; but the genus has not been found in the shelly beds of the formation. Height and diameter through both valves equal, or half the longitudinal diameter.

Locality. Minchinhampton.

GONIOMYA HEMICOSTATA. Tab. XII, fig. 3.

Testâ ovato-elongatâ, convexâ; umbonibus ante-medianis magnis subcompressis, margine antico oblique-declivi, postico subhorizontali, concavo-hiante; superficie in medio oblique, depresso, costis crebris biangulatis aut trapeziformis instructis; costis inferioribus evanescentibus.

Shell ovate, elongated, convex, gaping posteriorly with a considerable aperture; umbones anterior to the middle of the shell, large, elevated, but somewhat compressed; anterior border sloping obliquely downwards, posterior border lengthened nearly horizontal and concave; the middle portion of the shell has a wide depression which passes from the umbo directed slightly backwards and vanishing towards the inferior border; the superior and middle portion of the surface has numerous closely arranged costæ directed upon each side obliquely downwards towards the other, but connected with it by a horizontal straight costa; the lower half of the shell and the two extremities are altogether smooth. Outer or granulated layer of the test unknown.

A single well-preserved cast with the valves in contiguity is our only authority. The several features of this remarkable species clearly separate it from any other of the British *Goniomyæ*, the general figure with its elevated broad umbones, concave superior border, gaping and slightly reflected posterior extremity combined with the wide mesial depression, present no inconsiderable resemblance to a diminished figure of the great *Panopæa Aldrovandi*; the trapeziform direction of the costæ is governed by the mesial depression, and exists in those species only of the *Goniomyæ* in which this depression is well marked, thus in *Pholadomya trapezina*, Buv., *Lutraria trapezicostata*, Pusch., and *Goniomya inflata*, Ag. the horizontal costæ extend, with the depression, even to the lower border of the valve; in the present species they extend, with the depression, about half the depth of the valve, and in others, such as *G. Dubois*, Ag. *G. v.—scripta*, and *G. litterata*, the depression and

horizontal costæ only exist upon the umbo. Unfortunately our specimen has no portion of the granulated outer surface preserved.

Length, 19 lines ; height, 12 lines ; diameter through both the valves, about 8 lines.

Locality.—Blisworth, Northamptonshire.

PHOLADOMYA, Sow.

Shell thin, inæquilateral, ventricose, oval or oblong ; the borders of the valves more or less gaping, especially at the posterior extremity ; the umbones are large, contiguous, the apex of the one slightly impressing the other ; the ligament external, and placed in an oval depression, the surface is ornamented with costæ radiating from the umbones, which are regular and equal or irregular and unequal, smooth and rounded, or deeply notched and nodulous ; the entire surface has concentric plications which vary in their regularity, size, and prominence. The hinge is without teeth, but has an elongated lamina situated beneath the ligament.

The costæ are very commonly more numerous and prominent in the right valve than in the left.

The muscular impressions are faintly marked and cannot usually be distinguished ; the anterior impression is pyriform and elongated upwards towards the umbones, the posterior muscle is rounded, the syphonal scar has a considerable flexure.

PHOLADOMYA ACUTICOSTA, Sow. Tab. XIII, fig. 13.

PHOLADOMYA ACUTICOSTA, Sow. Min. Con., t. 546, f. 1, 2.

Testá ovato-elongatá ; umbonibus crassis, antemedianis, latere antico brevi rotundato, posteriore producto angustato, costis elatis acutis, anticis magnis remotiusculis et irregularibus ; posticis numerosis crebris et tenuibus ; striis concentricis decussatis.

Shell ovately elongated ; umbones thick, placed anterior to the middle of the valves ; anterior side short and rounded ; posterior side more produced and narrow ; costæ elevated, acute ; the anterior costæ large, rather remote, unequal, and placed at irregular intervals ; the costæ posteriorly are less elevated, numerous, and very closely arranged, gradually decreasing in distinctness towards the posterior extremity of the shell ; the costæ are decussated by concentric striations.

Our species is distinct from *Pholadomya acuticosta*, Rømer, tab. ix, fig. 15 ; and from Goldfuss, tab. cxxxvii, fig. 4 ; these, and likewise *P. multcostata*, Agassiz, tab. ii, figs. 3, 4, have the anterior costæ regular and less prominent than in our species ; the *P. multcostata* varies very considerably in its length, but our species is nearly uniform in figure.

Localities.—The upper beds of the Great Oolite, near Minchinhampton ; the slate of Stonesfield.

PHOLADOMYA SOCIALIS. Tab. XI, fig. 7, 7a.

Testá nucleo mediocri magnitudini, ovato ventricosá, latere antico brevi et gibboso, lateré postico elongato, attenuato, et hianle; umbonibus anticis magnis; area cardinali elongatá et planatá; marginibus anticis et posticis curvatis; plicis longitudinalibus magnis irregularibus; costalis radiantibus (circa 6) obscuris, aut evanescentibus.

Shell with the nucleus moderately large, ovately ventricose; anterior side short and gibbose; posterior side elongated, attenuated, and gaping, with a lengthened but narrow aperture extending upon the superior and posterior border to its junction with the hinge border; upon the anterior border there is scarcely any perceptible aperture. The umbones, which are placed anteriorly, are moderately large; the cardinal area is lengthened and rather flattened; both the anterior and posterior extremities are rounded, and pass insensibly into the superior and inferior borders. The longitudinal plications are large and irregular, with deep furrows between them, but they become less prominent, and are almost lost as they approach the posterior extremity. The radiating little costæ are distinct only upon the umbones; they are about six in number, but not unfrequently they are absent altogether.

This species presents its full share of variations of figure, not unfrequently the anterior side appears compressed, and forms an obscure angle or rib, extending from the umbones to the inferior border; we have never seen the test preserved, but the nuclei display all the more delicate features of the shell; there are no traces of muscular or pallial impressions. It was eminently gregarious, and occurred in a bed of buff-coloured calcareous sandstone, situated nearly 100 feet above the fullers' earth, and associated with *Lucina Orbigniana*, *Ceromya Symondsii*, *Ceromya undulata*, and other characteristic forms.

The examination of a large number of specimens has enabled us to affirm its distinctness from the *P. leviuscula*, Agassiz; a shell which is not so much elongated and attenuated posteriorly, and whose radiating costæ, though delicate, are visible over the sides of the shell, even to the inferior border. The large plications and more ventricose form distinguish it from *Pholadomya inornata*, Sow., 'Geol. Trans.' 2d ser., vol. v, pl. xxi; other species are more distantly allied.

Localities.—Small road side excavations two miles east of Minchinhampton; Blisworth, Northamptonshire.

PHOLADOMYA OVULUM, Ag. Tab. XIII, fig. 12.

Testá ovatá; umbonibus magnis anticis subdepressis, latere antico brevi, convexo, margine rotundo, latere postico elongato et attenuato; aperturá parvâ, margine ligamenti obliquè declivi, inferiore curvato; lateribus costis radiantibus distantibus paucis, plicis longitudinalibus impressis.

Shell ovately elongated; convex anteriorly, attenuated posteriorly; anterior side short, its border rounded; posterior side lengthened and attenuated, its aperture small; ligamental border nearly straight, sloping obliquely downwards, lower border curved; radiating costæ (about 7) distant, equal, spreading over nearly the whole of the shell, and rendered nodulous by some large longitudinal plications; the costæ of the left valve more prominent than those of the right. The convexity of the valves is considerable towards the anterior side; the umbones, though large, are but little elevated, and these features, together with the few distant and large knotted costæ, will serve to distinguish it from the Inferior Oolite *Pholadomya ovulum*, Ag., and *Pholadomya ovalis*, Sow., to both of which species it has some affinities; from the *Pholadomya Murchisoni* from *Brora*, it is distinguished by having a more elongated form, and much more distantly arranged costæ, so that only a small portion of the test is without them.

Dimensions.—Length, 2 inches; height, $1\frac{1}{4}$ inch; diameter through both the valves, 1 inch.

Geological position and localities.—We are not aware that this species has occurred except in the Great Oolite of the North of England; the specimens forwarded to us are from Scarborough, and from the vicinity of Stamford.

PHOLADOMYA SÆMANNI. Tab. XI, fig. 1, et Tab. XV, fig. 3.

Testá ovato sub-compressá; umbonibus elatis magnis; latere antico brevi, rotundo; postico sub-compresso, brevi; aperturá angustá; costis radiantibus, 7-8 depressis, subrectis subæqualibus, et remotis; plicis longitudinalibus impressis.

Shell ovate, rather compressed; umbones elevated and large; anterior side short, rounded, posterior side rather compressed and short, gaping, with a narrow aperture; radiating costæ 7-8 depressed, nearly straight, equal, regular, and remote; decussated but not much impressed by the longitudinal plications. The lateral diameter is somewhat less than the height, and exceeds considerably the diameter through both valves; but there is some variation in these proportions, the specimens which have the least convexity being usually less regularly ovate and rounded at their borders, so that they might, perhaps, be divided into two varieties.

From *P. solitaria* it is distinguished by the compressed posterior extremity, by the smaller convexity of the valves, and by the character of the costæ, which are less elevated and diverge so much more considerably that they nearly occupy the surface of the valves.

Localities.—Small openings or pits in the Great Oolite near to its base, and in the vicinity of the village of Avening. Scarborough, in the Great Oolite.

PHOLADOMYA SOLITARIA. Tab. XII, figs. 2, 5? *var.* of *P. producta*, Sow.

Testá ovato-subglobosá; umbonibus magnis, latis, medianis; lateribus brevibus, posticè lævi, aperturá angustá; costis (7) perpendicularibus elatis approximatis, æqualibus, læviter impressis; plicis concentricis tenuibus.

An ovately globose large species, with elevated median and broad umbones; the sides of the shell are short, the posterior side being destitute of costæ, its aperture is inconsiderable; the costæ (7 in number) are large, equal, but little divergent, and only slightly indented by the concentric plications, which latter are not conspicuous.

The height always exceeds the lateral diameter, and that through both the valves, the two latter measurements being nearly equal.

The combination of broad umbones, with equal little impressed perpendicular costæ only slightly radiating, together with the short but not truncated sides, will suffice to distinguish it from contemporaneous species.

Geological position and localities.—All our specimens are from the Minchinhampton district, they have been procured at several localities in oolitic sandstone a little higher than the fullers' earth, and obtained by well sinkings, they were unaccompanied by any other fossil.

PHOLADOMYA HERAULTI, *Ag.* Tab. XV, fig. 4, *var.* Tab. XII, fig. 1.

PHOLADOMYA MURCHISONI, *Ag.* Etud. Crit., p. 79, t. 4 c, f. 5, 7.

— — Roemer. Nordd. Ovl., p. 128, t. 15, f. 7.

— HERAULTI, *Ag.* Etud. Crit., Appendice, 1845.

Testá ovato-globosá; umbonibus magnis anticis, serratis; areá cardinali magná, elongatá, latere postico modico hiante, latere antico brevi, costis (circá 9) obliquis, elevatis plicis longitudinalibus impressis; costá primá obscurá, costá secundá majorá et elevatá.

Shell ovately globose; umbones large, anterior, and serrated; cardinal area large and depressed, posterior side gaping with a lengthened and moderately large aperture, anterior side short, slightly truncated; the radiating costæ, (usually 9 in number,) are large and elevated, the posterior ones are oblique; the first is only slightly marked, the second is the largest and most elevated; they are strongly impressed or rendered nodulous by the longitudinal plications; the two extremities of the shell are destitute of costæ.

This shell is more elevated, and the prominence of the second rib will suffice to separate it from *P. Murchisoni*, with which it has been confounded.

Geological position and localities.—*Pholadomya Heraulti* occurs not unfrequently in certain sandstone beds of the Great Oolite, in Gloucestershire; also at Blisworth, Northamptonshire, but the dimensions of these specimens are usually small; in the Inferior Oolite it appears to range throughout the extent of that formation in this country, in which it attains its full dimensions, and is very common.

HINNITES ABJECTUS, *Phil.*, sp. Tab. IX, fig. 7, and Tab. XIV, fig. 3.

PECTEN ABJECTUS, *Phil.* Geol. York., 1, t. 9, f. 37.

— — Morris, Cat. Brit. Foss., 1854, p. 175.

Testá suborbiculari convexá; auriculá anticá productá lineatá, posticá subobsoletá; costellis rádiantibus numerosis (80 ad 100) irregularibus inæqualibus nodulosis et transversè striatis; interstitialibus interdum lineisque tenuissime notatis; valvâ propè mediam costellis 2 vel 3 elevatis acutis sed nodulosis instructá. Valvâ alterá planatá, delicatissimá lineis tenuissimis et undulatis non nunquam obsoletis.

Shell, when not distorted, sub-orbicular and convex; the umbones small and depressed; the anterior auricle produced, the other usually indistinguishable; the radiating little costæ are very numerous, (from 80 to 100,) irregular, unequal, nodulous, and transversely striated; the interstitial spaces have likewise more minute costæ or lines, which are also nodulous, unequal in size, and uncertain in number; the auricle has these fine irregular lines; there will also constantly be noticed, towards the middle of the valve, two or three costæ, which are larger and more elevated than the others, they are acute but nodulous, and will alone at once serve to distinguish the species from *Hinnites velatus*, to which the general character of the surface offers a considerable resemblance. The figure of the latter and smaller species, however, is more fan-shaped or less orbicular and less convex. The other valve, which is very rarely seen, is extremely delicate and flattened, its surface has numerous very fine waved radiating lines, which are occasionally indistinct.

The numerous examples which we have obtained of this imperfectly known species exemplify its extreme irregularity of contour and convexity, not one is altogether regular; the test is thin, and there can be no doubt that it readily assumed the figure of any surface to which the flat valve was attached. In young examples the two or three more elevated costæ form a conspicuous feature which becomes less remarkable with the increase of the dimensions. Our largest example is upwards of four inches across.

Geological position and localities.—*Hinnites abjectus* is found in the Coralline Oolite of Malton, in the Great Oolite of Whitwell, and in the Inferior Oolite of Glaizedale, Yorkshire; it is also not uncommon in the upper division of the Inferior Oolite of Gloucestershire, but it has only occurred very rarely in the Great Oolite of the Minchin-hampton district.

PHOLAS. *Linn.* 1758.

Shell elongated, sub-cylindrical, gaping at both the extremities; umbones incurved and contiguous. Hinge thickened, reflected to form a plate which covers the umbo in each valve; internally it has a curved spatulous tooth which projects in each valve.

PHOLAS OOLITICA. Tab. IX, fig. 21.

Testá parvá ovatá, anticè convexá, posticè compressá, dorso in medio sulco profundo; costulis radiantibus acutis, anticis magnis distantibus, posticis crebris; plicis longitudinalibus regularibus imbricatis.

Shell small, ovate, anterior side convex, posterior side rather compressed and attenuated; the dorsal surface with a deep mesial depressed line, which extends from the umbo to the inferior border; radiating costæ acute, elevated, and distant upon the anterior side, less elevated and more numerous posteriorly; they are indented by longitudinal plications, or lamellæ, which are regular and imbricated.

The test of this small species is very delicate; in adult specimens the umbones are placed one third from the anterior extremity; the convexity at that part is equal to the height, or about half of the length; young examples are shorter in proportion, and the mesial furrow is more strongly marked. The *Pholas crassa*, of Deslongchamps, 'Mém. Soc. Linn. de Normandie,' 1839, pl. ix, figs. 1, 3, 5, 7, has a similar or perhaps shorter figure; it has prominent but fewer imbricated folds, and it would appear to be destitute of the radiating costæ which ornament our species.

Length of our largest specimen, 10 lines; height and diameter through both the valves, $5\frac{1}{2}$ lines.

Localities.—Minchinhampton and Bisley Commons, Gloucestershire.

YORKSHIRE SHELLS.

OSTREA MARSHII, Sow. Tab. XIV, fig. 2, 2 a.

- | | | |
|-------------------|------------------|--------------------------------------|
| OSTREA DILUVIANA, | Park. | Org. Rem., 3, t. 15, f. 1. |
| — | — | Zeiten. Petref., t. 46, f. 1. |
| — | MARSHII, Goldf. | Petref., t. 73. |
| — | — | Roemer. Verst. Ool., p. 58. |
| — | SULCIFERA, Phil. | Geol. York., 1, t. 9, f. 35, junior. |

Testá subsolitariá subæquivalvi, ovato-trigoná, convexo-planá, crassá, plicis radiantibus, magnis inæqualibus acutis subimbricatis. (Roemer.)

Shell subequivalve, either ovately oblong or fan-shaped; umbones small, terminal; the dorsal surface near to the umbones, has a mesial elevated smooth longitudinal ridge fringed upon each side with acute radiating plications, towards the lower border.

The central ridge divides into several very elevated acute costæ; the interstitial spaces of which, form acute angles with them; the substance of the test is thick. The *Ostrea sulcifera*, Phil., of which we have a specimen from Whitwell, Yorkshire, is only the germ of this large species, in which the central longitudinal smooth ridge has not divided to form the great posterior denticulate plications, the latter change having taken place at a subsequent period of its growth. In the adult condition the figure is sometimes a lengthened oval or oblong as in *O. sulcifera*, but, in other instances, which probably represent the final stage, the lower and larger plications spread out laterally, giving the shell a fan-shaped contour.

Geological position and localities.—We have received *O. Marshii* from the grey limestone of the Great Oolite near Scarborough; we have collected it in the Cornbrash near to Malmesbury, and it occurs not uncommonly in the upper division of the Inferior Oolite in the Cotteswolds. *Ostrea sulcifera* is from the Great Oolite of Whitwell, Yorkshire.

GRYPHÆA MIMA, Phil. Tab. XIV, fig. 5.

GRYPHÆA MIMA, Phil. Geol. York., 1, t. 4, f. 6.

Testá parvá obliquá, subglobosá, valvá convexá, rugis concentricis magnis; areá adherenti magná, alterá convexo-planá.

Shell small, oblique, subglobose, the larger valve convex, rugose, with large concentric folds; the adherent surface subterminal, large; the smaller valve more smooth, slightly convex.

More globose than *Ostrea rugosa*, Sow., and destitute of the marginal plications; in other respects it much resembles that little species.

Height, 6 lines; lateral diameter, 5 lines; diameter through both the valves, 3 lines.

PECTEN DEMISSUS, Phil. Tab. XIV, fig. 7.

PECTEN DEMISSUS, Phil. Geol. York., 1, t. 6, f. 5.

— — Goldf. Pet., p. 74, t. 99, f. 2.

Testá suborbiculari planatá; umbonibus parvis acutis; auriculis parvis æqualibus, valvá dextrá subplaná, valvá sinistrá convexio; lateribus æqualibus marginibus rotundis; superficií glabro lineis tenuissimis concentris, aliis subobsoletis radiantibus decussatis.

Shell suborbicular, depressed, smooth and shining; umbones small, acute; auricles small, equal, rising slightly at their extremities, their outer borders curving obliquely downwards; the margin of the valves slope downwards from the umbones nearly at an equal angle on each side, (about 40° to the axis of the valves) and the margins and base are regularly rounded; the right valve has only a very slight convexity, and sometimes is traversed on each side obliquely by a slight furrow diverging from the umbo; the left

valve is somewhat more convex; the shining surface of the valves discloses closely arranged, very delicate and unequal concentric lines, which are decussated by radiating lines, equally dense, but slightly waved and knotted when viewed under a magnifier; the auricles are densely striated. The auricles are so small, that the length of their superior border is less than a third of the height of the shell, the measurement of the lateral diameter being equal to the height. The specimen forwarded to us from Yorkshire, is only 14 lines across, and agrees with small examples from the Inferior Oolite of the Cotteswolds, in which latter rock the species attains to thrice this measurement.

Geological position and localities.—The Coralline Oolite of Malton, the Kelloway rock of Scarborough, the Cornbrash of Gristhorpe, the Great Oolite or grey limestone at Cloughton, and the bed called Trigonía Grit, in the Inferior Oolite of the Cotteswolds; it would appear to be abundant in each of these positions.

PERNA RUGOSA, Goldf. var. Tab. XIV, fig. 16, *et antea*, Tab. III, fig. 1.

PERNA QUADRATA, Phil. Geol. York., t. 9, f. 21, 22.

— — Goldf. Pet., t. 107, f. 12.

Testá ovato-sigmoideá convexo-planá, in alam brevam productá; umbonibus acutis prominentibus; margine cardinali obliquo, canaliculis (8—12) plano concavis. (Goldfuss.)

A subquadrate thick shell, with a lengthened and large series of hinge-grooves; the apex is pointed, and projects forwards, beneath which the anterior border is concave and in-crassated, the lower border is rounded, the posterior side of the shell is thin, and its border nearly straight. The surface has irregular concentric plications, which, however, are not very prominent.

Aged specimens acquire a very considerable degree of elongation, the opposite measurement upon the hinge border having but little increase, usually the figure is more quadrate or less sigmoidal than is represented by Goldfuss.

Geological position and localities.—In Yorkshire, *P. rugosa*, var. *quadrata* occurs in the grey limestone of the Scarborough Great Oolite; in the Cotteswolds, we have examples both from the lower and upper division of the Inferior Oolite.

PTEROPERNA PLANA. Tab. XIV, fig. 4.

Testá obliquá, alatá, lineá cardinali recto elongato, postico valdè producto, valvis subæqualibus, depressis, inornatis; plicis concentricis irregularibus.

Shell oblique, winged; umbones small, acute, curved forwards, and placed near to the anterior extremity of the hinge-line, above which they are scarcely elevated; hinge border lengthened, produced posteriorly into an extended and pointed wing; the valves are nearly equally flattened, the left valve being a little more convex than the other; they are

destitute of ornament, and have only irregular concentric plications. The anterior border beneath the short anterior wing is but little excavated, its aperture being very narrow; the lower side of the shell has not much obliquity, and its border is regularly rounded. Two ribs extend the length of hinge border immediately beneath it, as is usual in the *Pteropernæ*.

In size it equals the larger specimens of our *P. costatula*, but it is less oblique than that species: the left valve is much less convex, and the anterior sinuation is much less considerable; the umbones are smaller, and are much less elevated above the hinge border; the anterior auricle is nearly upon the same plane as the posterior, but in *P. costatula* it is directed obliquely downwards and forwards.

Geological position and locality.—The Grey Limestone of the Scarborough Great Oolite.

AVICULA MUNSTERI, Goldf. Tab. XIV, fig. 6.

Testá (valva major) ovatá, obliquá, subconvexá, alá anticá acutá, posticá falciformi; costis radiantibus (3-4) acutis lineisque interstitialibus inæqualibus.

Shell very oblique and convex, inequivalve; anterior auricle acute; posterior auricle more lengthened and falciform; the larger valve with regular equal radiating slightly knotted costæ (about 16 in number); in the middle of each interstitial space is an elevated line, with one or more delicate or more faintly marked, upon each side of it; the auricles are ornamented in a similar manner.

An elegant shell, with convex prominent umbones, narrow but well marked costæ, which slightly project at the inferior border.

Geological position and locality.—The Great Oolite of Scarborough, in dark grey argillaceous sandstone.

AVICULA BRAAMBURIENSIS, Sow. Tab. XV, fig. 7, var. fig. 6.

AVICULA BRAAMBURIENSIS, Sow. Geol. Trans. vol. ii, p. 323.

— *BRAAMBURIENSIS*, Phil. Geol. York., 1, t. 6, f. 6.

Testá ovato obliqua, alá anticá rotundatá, posticá obtusiangulá, valvá majorá convexá, lineis radiantibus confertis minoribus alternis, interstiis angustis tegulatis. Valvá minorá convexo-planá lævigatá, lineis radiantis paucis distantibus subobsoletis.

Shell ovately oblique; anterior auricle small, rounded, posterior auricle forming an obtuse angle; the larger valve convex, with numerous radiating lines, alternating with others which are smaller and indistinctly marked; the interstitial spaces narrow and indistinctly tegulated. The smaller valve slightly convex, smooth, with a few (7) radiating lines faintly marked.

The figure is remarkable for the smallness of the auricles and lengthened outline; the convexity is less than is usual in other of the ornamented aviculæ of the Lower Oolites.

It would appear to be nearly allied to a species which occurs in the Inferior Oolite of the Cotteswolds, from which it is distinguished by the shorter hinge border, less convex form, and fewer radiating costæ; it is not, however, quite certain that the Inferior Oolite shell may not be only a variety.

Locality.—Scarborough, in the bed of Grey Limestone.

PINNA CANCELLATA, *Bean*, MSS. Tab. XIII, fig. 20a, b.

Testá ovato-lanceolatá, quadriquetrá, anticè convexá plicis magnis concentricis; posticè compressiusculá; striis transversis crebris et lineis radiantibus angustis nodosis distantibus decussatis.

Shell ovately lanceolate, straight, quadriquetral, anterior side convex, with large densely arranged irregular, concentric plications; middle and posterior side more compressed, with fine irregular striations crossed by a few (about 12) longitudinal radiating knotted lines.

The single valve at our disposal does not exemplify the convexity and figure of the posterior aperture. It appears most nearly to resemble *Pinna Hartmanni*, Goldfuss, but it is more straight, with much fewer radiating lines, none of which are visible upon the anterior slope.

Locality.—Scarborough, in the Grey Limestone.

LIMA PUNCTATA, *Sow.*, sp. Tab. XV, fig. 9a, b.

PLAGIOSTOMA PUNCTATUM, *Sow.* Min. Con., t. 113, f. 1, 2.

LIMA PUNCTATA, *Goldf.* Petref., p. 81, t. 101, f. 2.

PLAGIOSTOMA PUNCTATUM, *Morris.* Catal., 1843, p. 117.

Testá ovato-obliquá, convexo-planá; margine antiore subrecto, elongato, abruptè truncato; lunulá excavatá; auriculis parvis inæqualibus; margine posteriore et inferiore rotundo; superficie lævi striis angustis, numerosis sub-flexuosis, densè punctatis.

Shell ovately oblique, rather flattened; anterior margin nearly straight, truncated, elongated; lunule large, excavated; auricles small, unequal; the posterior and inferior borders of the valves regularly rounded; the surface is smooth, with very numerous, narrow, slightly waved, and densely punctated striations, crossed by a few irregular folds of growth.

The smooth shining surface, densely arranged striations which cover the entire surface of the shell, and flattened elongated form, readily serve to distinguish it from other species of the lower oolites.

Localities.—The specimen forwarded to us from Yorkshire is from the hard Grey Limestone of Scarborough. In the Cotteswolds it occurs abundantly in the Inferior Oolite; but it has not occurred in the Great Oolite of the latter district.

HINNITES ABJECTUS, *Phil.* Tab. XIV, fig. 3, *vide antea*, p. 125.

MYTILUS (MODIOLA) CUNEATUS, *Sow.* Tab. XIV, fig. 9.

MODIOLA CUNEATA, *Sow.* Min. Con., t. 248, f. 2.

— — *Phil.* Geol. York., 1, t. 5, f. 28.

Testá ovato elongatá, convexá; umbonibus subterminalibus parvis curvatis, acutis; margine antico subsinuato; margine cardinali oblique declivi, curvato, dorso obtusè fornicato, anticè subdepresso, superficie; lineis concentricis tenuissimis irregularibus.

Shell ovately elongated, convex; umbones nearly terminal, acute, and incurved; hinge margin sloping obliquely and curved; anterior margin nearly straight, but slightly sinuated; dorsal surface obtusely ridged, most elevated about the middle of the valve, forming a depressed surface anteriorly and obliquely to it; the surface with fine irregular concentric lines or striations.

The acute umbones, depressed and wedge-shaped anterior side, and slight obliquity of the entire form, serve to distinguish it from other species of the Lower Oolites.

Geological position and localities.—At Scarborough, in the Great Oolite; Somersetshire, in the Inferior Oolite.

MYTILUS (MODIOLA) LECKENBII. Tab. XIV, fig. 8.

Testá ovato, arcuatá, convexá, acutá et obliquè fornicatá; anticè angusto posticè lato; umbonibus subterminalibus acutis; dorso fornicato, latere anteriore sulcato et sinuato; superficie striis tenuissimis, crebris, irregularibus.

Shell curved, ovate; anterior extremity rounded but narrow, posterior extremity wide and curved obliquely; umbones nearly terminal and acute; dorsal surface with an elevated narrow ridge, anterior to which is a depressed and sinuated surface, the anterior border of which is much excavated, and its lower extremity rather pointed; the hinge margin is lengthened, sloping downwards obliquely, and but very slightly curved; the surface has closely arranged very fine concentric striations.

The great obliquity of the valves, the deeply sinuated anterior border, the pointed inferior extremity, and the flattened but raised posterior surface, will serve to distinguish it from *Mytilus (Modiola) bipartita*, to which its acute dorsal ridge presents a resemblance.

Length, 16 lines; opposite diameter, 8 lines; diameter through both the valves, 8 lines. The name is in complement to John Leckenby, Esq., of Scarborough, to whom we are indebted for the loan of the specimen.

Geological position and locality.—The Great Oolite of Scarborough, in a bed of hard grey ferrugino-micaceous sandstone.

MYTILUS (MODIOLA) UNGULATUS. Tab. IV, fig. 5 (*M. tumidus*).

M. UNGULATA, *Young and Bird*. Geol. Yorksh., pl. 7, f. 10.

M. TUMIDUS, *antea*, p. 37, pl. iv, f. 5.

This species has been previously figured under the name of *M. tumidus*, p. 37, but it is not distinct from the Yorkshire shell, and the latter name cannot therefore be retained.

CUCULLÆA CANCELLATA, *Phil.* Tab. XIV, fig. 12.

CUCULLÆA CANCELLATA, *Phil.* Geol. York., 1, t. 9, f. 24, t. 11, f. 44.

— OBLIQUA, *Lycett*. Ann. and Mag. Nat. Hist., 1850.

Testá ovato-rhomboided perobliquá ; umbonibus antemedianis contiguís, latere antico brevi, latere postico fornicato obliquè declivi et producto ; superficie lineis radiantibus minutis crebris aliis concentricis decussatis.

Shell ovately rhomboidal, very oblique ; umbones placed near to the anterior extremity of the hinge line, and contiguous ; anterior side short, its margin rounded, posterior side with an oblique ridge, obtuse, and much elongated posteriorly ; the surface with very densely arranged, equal, regular, radiating lines, decussated by others concentric and equally densely arranged ; the lines are smooth, and the angles produced by the junction of the decussating lines have a punctated appearance ; upon the anterior side of the shell the radiating lines are rather less densely arranged.

The surface of this species has a considerable resemblance to *Cucullæa cucullata*, Goldfuss, but the latter shell is more convex and is less elongated, the area being likewise larger.

Geological position and localities.—At Scarborough, in the hard grey limestone of the Great Oolite ; in Gloucestershire, it occurs in the middle division of the Inferior Oolite.

UNICARDIUM GIBBOSUM. Tab. XIV, fig. 11.

Testá ovato subglobosá ; umbonibus magnis medianis, curvatis ; margine cardinali brevi, subrecto, et subhorizontali ; marginibus aliis curvatis ; superficie plicis magnis irregularibus et inæqualibus.

Shell ovately sub-globose ; umbones large, mesial, prominent, and curved forwards ; hinge margin short, nearly straight, and horizontal, its posterior extremity rather angulated, the other margins of the valves regularly rounded ; the surface is covered with large, irregular, and unequal concentric plications ; the thickness of the test is moderate.

The umbones are more nearly mesial than *U. depressum* and *U. impressum* ; they also project more, and therefore more nearly resemble *U. varicosum*, but the anterior side is

less produced, and the height is much less than in that shell; it is more nearly allied to, but is more oblique, than a large *lias* species which is not uncommon in Gloucestershire and Oxfordshire. Height and diameter through both the valves equal, lateral diameter one fourth more. The specimen forwarded to us from Yorkshire is much smaller than several which we have obtained in the Cotteswolds, in one of which the lateral diameter exceeds two inches.

Geological position and localities.—The Great Oolite of Scarborough; also in the middle or freestone beds of the Inferior Oolite in Gloucestershire; but it has not occurred in the Great Oolite of the same county.

UNICARDIUM DEPRESSUM, *Phil.* sp. Tab. XIV, fig. 10.

CORBULA DEPRESSA, *Phil.* Geol. York., 1, t. 9, f. 16.

Testá ovato subglobosa; umbonibus magnis, subanticis incurvis, margine cardinali oblique declivi subrecto, basi et lateribus rotundis; plicis concentricis crebris irregularibus et inæqualibus.

Shell ovately globose, oblique; umbones large, depressed, anterior to the middle of the valves; hinge border sloping obliquely downwards and nearly straight, its posterior extremity rounded; the margins of the valves, basal, anterior, and posterior, rounded; the general figure tumid, excepting near to the hinge border, where the surface is more depressed; the surface is covered with closely-arranged concentric plications which are irregular and unequal.

The substance of the test is of greater thickness than is usual in this genus; it is most nearly allied to *U. varicosum*, p. 73, tab. 8, figs. 7—8; but it is much more oblique and of greater length, the dimensions being, height, 14 lines; length, 17 lines; there is some amount of variation in the obliquity of the valves and we have specimens which exhibit greater obliquity than the example from Yorkshire.

Geological position and localities.—The grey limestone of the Great Oolite at Scarborough. In Gloucestershire it has occurred only in the Inferior Oolite in the bed called Trigonía Grit.

TRIGONIA DECORATA, *Lyc.* Tab. XV, fig. 1.

TRIGONIA DECORATA, *Lycett.* Ann. and Mag. Nat. Hist., 1853, vol. xii, pl. 11, f. 1.

Testá ovato trigona, subcompressa, umbonibus obtusis, non recurvatis, areá cardinali latá planá tripartitá; cariná interná tuberculis in varicis elongatis instructús, cariná mediá et marginali tuberculis minimis crebris ornatá: lateribus tuberculis per series arcuatis concentricè dispositis.

Shell ovately trigonal, somewhat depressed; umbones obtuse, not recurved; anterior

and inferior borders rounded, posterior border lengthened and nearly straight; area wide, flattened, finely striated transversely, and divided into three portions by as many faintly traced carinæ, or rather as many lines of minute closely-arranged equal and regular tubercles, those of the inner carina, being elongated into as many varices or plications; there is, likewise, a median divisional groove, which is immediately adjacent to and parallel with the tubercles of the median carina. The clavellated portion of the shell has a numerous series of rows of concentric closely-arranged but not very prominent tubercles, the larger tubercles being towards the middle of the curvature; they are distinct, usually rounded, closely-arranged (15 or more being contained in a row), the number of rows in adult shells being about 20, the whole of which are distinctly tuberculated; the lines of growth upon the sides of the shell are fine and distinct. The dimensions are equal to the largest examples of the clavellated *Trigoniæ*. The species which approximate most nearly to our shell are *T. perlata*, Ag. *T. Bronnii*, Ag. *T. muricata*, Goldf. and *T. clavellata*, Sow., it having usually been mistaken for the latter shell.

T. perlata has the umbones more recurved; the tubercles upon the carinæ are much larger, and those of the median carina have in addition a series of transverse varices which are absent in *T. decorata*. *T. Bronnii* has the apex more elevated, it is destitute of the inner varices upon the area; the sides of the shell have a less numerous series of rows of tubercles, the tubercles being larger.

T. muricata has the area much smaller and more narrow; the lanceolate post ligamental space is smooth; the costæ upon the sides of the shell are distinctly elevated, the tubercles being more prominent and more distantly arranged in the rows.

T. clavellata has the figure more elongated and rostrated posteriorly; the umbones are much more recurved; the superior border of the area is distinctly concave; the lanceolate space is of great size, and the inner carina is destitute of varices; the sides of the valves have the rows of tubercles fewer, the tubercles more elevated and more distantly arranged in the rows; the general convexity of the valves being greater than in *T. decorata*.

The specimen forwarded to us from Yorkshire, is rather more elongated, and the costæ are somewhat more prominent than obtains in specimens from Gloucestershire; but there appears to be no essential difference between them.

Geological position and localities.—The Great Oolite of Scarborough; it is abundant likewise in the bed called Trigonia Grit of the Inferior Oolite in the Cotteswolds.

ASTARTE MINIMA, *Phil.* Tab. XIV, fig. 15.

ASTARTE MINIMA, *Phil.* Geol. York., 1, t. 9, f. 23.

— — *Williamson.* Geol. Trans., 2d ser., vol. v, pt. 1, p. 240.

Testâ parvâ ovato-acutâ convexâ; umbonibus prominulis obliquis; superficie apice lævigato; dorso striis concentricis magnis irregularibus.

Shell small, ovately acute, convex; umbones prominent, pointed, oblique; margins of

the valves rounded; the surface smooth near to the apex, the remaining portion with large concentric irregular striations.

Locality.—This small species is not uncommon upon the slabs of Brandsby slate, and near Scarborough; it has not been identified in Gloucestershire. Mr. Williamson records it both in the Great and Inferior Oolite of Yorkshire.

ASTARTE ELEGANS, *Sow.* Tab. XIV, fig. 14, *vide antea*, p. 86.

CYPRINA ? DOLABRA, *Phil.*, sp. Tab. XIII, fig. 19.

CYTHEREA DOLABRA, *Phil.* Geol. York., 1, t. 9, f. 12.

Testá parvá ovato-orbiculari, plano-convexa lævigata; umbonibus subacutis medianis elevatis; marginibus rotundis; lunulá magná excavatá.

Shell small, ovately orbicular, rather flattened, smooth; umbones mesial, rather acute, and elevated; margins of the valves rounded; lunule large and excavated.

The depressed figure, elevated acute mesial umbones, and large lunule, separate it from other small contemporaneous species of the Cyprinæ.

Height, 4 lines; length, 5 lines; diameter through both the valves, a line and a half.

Locality.—Scarborough, in the Great Oolite.

ISOCARDIA CORDATA, *Buck.* Tab. XV, fig. 5.

ISOCARDIA CORDATA, *Buckman.* Geol. of Chelt., p. 98, t. 7, f. 1.

Testá ovato orbiculari convexá, umbonibus magnis obliquis antemedianis antrorsum curvatis et separatis; areá ligamenti magná, sulco elongato, marginibus rotundis et integris; superficie lævi, striis concentricis tenuibus et irregularibus instructis.

Shell ovately orbicular or cordiform; very convex near to the umbones, but rather compressed at the margins, which are regularly rounded and entire; umbones large, curved forwards, and separated by a large and lengthened ligamental area, upon each side of which is a groove which extends nearly to the posterior extremity, and is bounded above by an angle which may be traced to the extremities of the umbones; the surface is smooth, with fine irregular concentric striations; test very delicate.

Dimensions of the Yorkshire specimen; height, 18 lines; length, 21 lines; diameter through the valves, 15 lines.

Localities.—Scarborough, in the Great Oolite; larger examples, some of which have the test preserved, occur in the Inferior Oolite of the Cotteswolds, but it is unknown in the Great Oolite of Gloucestershire.

QUENSTEDTIA LÆVIGATA. Tab. XIV, fig. 13.

PSAMMOBIA LÆVIGATA, *Phil.* Geol. York., 1, t. 4, f. 5.

Testá ovato-elongatá, compressá, lævigatá; umbonibus depressis, medianis; anticè

rotundo, postice subtruncato, angulo obliquo obtuso instructo; margine cardinali subhorizontali, inferiore parallelo; lateribus striis irregularibus tenuibus.

Shell ovately elongated, compressed and smooth; umbones depressed, mesial; anterior border rounded, posterior border somewhat truncated; an oblique obtuse angle descends from the umbo posteriorly; hinge border horizontal, lower border parallel, the surface with fine irregular longitudinal striations.

Compared with *Quenstedtia oblita*, this species is more elongated, the umbones more nearly mesial, and the longitudinal plications are much more delicate, producing a general smoothness of the surface. Length, 2 inches; height, 1 inch.

Geological position and localities.—Specimens have been forwarded to us from the Grey Limestone bed of the Scarborough Great Oolite; it also occurs in the Inferior Oolite of Blue Wick upon the same coast, and in the upper division of the Inferior Oolite of the Cotteswolds; we have also obtained a specimen in the Great Oolite of Minchinhampton, but it appears to be rare at each of these localities.

MYACITES BEANII. Tab. XV, fig. 11*a*, *b*.

Testá ovato-oblongá subcompressá, umbonibus depressis; antemedianis, areá ligamenti angustá, parvá; margine postico rotundo; hianté basi et margine anteriore curvato; superficie sulco lato, superficiali instructo; plicis longitudinalibus magnis irregularibus.

Shell ovately oblong, rather short and compressed; umbones antero-mesial, depressed; ligamental area small and narrow, the margin posterior to it nearly horizontal; the extremities of the valves rounded, the anterior extremity being almost closed, the posterior extremity with a lengthened and moderately large aperture; a superficial and vertical wide depression passes downwards from the umbones crossing the longitudinal plications, which are large and irregular.

This species is not without a considerable resemblance to *Homomya compressa*, Ag., but as the latter shell has the anterior side less produced, with a distinct aperture, together with umbones more elevated, we prefer to consider them distinct species; the short form, depressed small umbones, and fully developed nearly entire anterior border, will also serve to distinguish it from other of the British Myadæ. Length, $2\frac{1}{4}$ inches; height, $1\frac{1}{4}$ inch; diameter through the valves, 1 inch.

Locality.—Scarborough.

MYACITES SECURIFORMIS, *Phil.*, sp. Tab. XIII, fig. 15.

AMPHIDESMA SECURIFORME, *Phil.* Geol. York., 1, t. 7, f. 10.

PLEUROMYA SECURIFORME, *Ag.* Etud. Crit., p. 232.

Testá elongatá, securiformi, compressiusculá, umbonibus submedianis parvis, margine antico et postico oblique-declivi, basi elliptico curvato; valvis in medio subdepresso, plicis longitudinalibus magnis distantibus, lunulá nullá.

Shell elongated, subtrigonal or hatchet-shaped, umbones antero-mesial and small, anterior and posterior borders sloping obliquely downwards, the anterior slopes have the greater angle, lower margin curved elliptically; the extremities of the valves rounded, and no distinct aperture; the sides of each of the valves with a large superficial perpendicular mesial depression caused by a few large and distant longitudinal plications. The general figure is more compressed, the umbones more nearly mesial, and the extremities of the valves are more completely closed than is usual in this genus, there is also more or less degree of inequality in the valves. Numerous as are the forms of this genus, we have seen none which are likely to be confounded with the present species; some of the shorter specimens of *Pleuromya elongata*, Ag., resemble it in outline only, but the posterior aperture and greater convexity will at once distinguish the species of Agassiz.

Height, 13 lines; length, 22 lines; diameter through both the valves, 8 lines.

Localities. *Myacites securiformis* occurs abundantly in the Cornbrash both of Yorkshire and Wiltshire.

Mr. Bean has kindly forwarded us a fine specimen from the Great Oolite of Scarborough, which we have figured.

MYACITES DECURTATUS, *Phil.* Sp. Tab. XV, fig. 10a, b.

Syn. AMPHIDESMA DECURTATUM, *Phil.* Geol. York., 1, t. 7, f. 11.

PLEUROMYA DECURTATA, *Ag.* Etud. Crit. Myes., p. 232.

LUTRARIA DECURTATA, *Goldf.* Petref., t. 153, fig. 3.

Testá ovato-elongatá, umbonibus anticis elevatis, latere antico brevi, abruptè truncato, postico elongato, attenuato et hiantè; margine superiori obliquè declivi, basi curvato, lateribus plicis longitudinalibus irregularibus.

Shell ovately elongated, umbones anterior, elevated; anterior side short, truncated, with a superficial vertical depression; posterior side elongated and attenuated, superior margin sloping obliquely downwards, the extremity with an aperture of moderate size and elongated, lower border curved elliptically; the sides of the valves with longitudinal irregular plications.

Compared with its congeners, the elevated umbones, short anterior side, and lengthened attenuated posterior side, will usually serve to distinguish it; the middle portion of the shell is moderately tumid, the two extremities being somewhat compressed; the posterior aperture extends both upon the superior and inferior borders; we have not seen the outer granulated layer of the test.

Height, 11 lines; length, 20 lines; diameter through both the valves, 9 lines.

Locality. *Myacites decurtatus* occurs in the Cornbrash both of Yorkshire and of Wiltshire; we have also been favoured by Mr. Bean, with a specimen from the Great Oolite near Scarborough.

MYACITES SCARBURGENSIS, *Phil.* Sp. Tab. XV, fig. 13.

Syn. LUTRARIA GIBBOSA, *Phil.* Geol. York., 1, t. 9, f. 6.

Testá ovato-elongatá, compressiusculá, umbonibus antemedianis parvis, margine antico rotundo, producto, postico elongato, hiante; basi elliptico curvato, margine superiori subhorizontali, concavo; lateribus compressis, plicis irregularibus magnis longitudinalibus.

Shell ovately elongated, compressed; umbones anterior to the middle of the valves, small and not much elevated; anterior side produced, its margin rounded; posterior side lengthened, and gaping with a moderately large aperture; base curved elliptically; the sides of the valves are compressed, and have large irregular longitudinal plications; the ligamental area is large and excavated, the posterior aperture extending upon the horizontal superior border nearly to the ligament.

A species somewhat resembling *Myopsis Jurassi*, Ag., but less tumid, or more compressed in its middle part.

Height, 17 lines; length, 31 lines; diameter through both the valves, 12 lines. The specimen figured is the original one drawn by Professor Phillips.

Locality. Scarborough. Mr. Bean's Collection.

MYACITES GIBBOSUS, *Sow.* Sp. Tab. XII, fig. 14, (junior.)

Syn. PANOPÆA GIBBOSA, *Sow.* Min. Con., t. 211.

— AGASSIZII, *Valenc.* Arch. du Mus., 1, p. 31.

MYACITES GIBBOSUS. *Morris.* Catal. 2d edit., 1854, p. 213.

MYA GIBBOSA, *D'Archiac.* Mem. Soc. Geol. Fr., vol. 5, pl. 26, f. 1, 1845.

— MODICA, *Bean.* MSS. (junior.)

Testá ovato-oblongá, ventricosá, umbonibus rotundis, magnis, elevatis ante medianis, latere antico brevi, margine rotundo, latere postico compresso, margine aperturá angustá, basi elliptico curvato; margine superiori concavo; areá ligamenti magná, ellipticá; lateribus striis irregularibus tenuissimis.

Shell ovately oblong, ventricose; umbones rounded, large, elevated, and placed anterior to the middle of the valves; anterior side short, convex; its margin rounded, gaping with a small aperture; posterior side compressed, its extremity with a narrow lengthened aperture; base elliptically curved; superior margin rather concave; ligamental area large, elliptical, depressed; sides of the valves with fine irregular longitudinal striations.

The small specimen forwarded us from the Great Oolite of Scarborough, is the young

condition of the large and well-known *Panopæa gibbosa*, Sow., a species in which the test has not been observed, and which in the Cotteswolds and West of England, is procured in the upper portion of the Inferior Oolite; our small example is more than usually elongated, but the species differs very much in this particular, and we possess examples from the Inferior Oolite in which the posterior side is fully as much elongated. The large elevated umbones and tumid anterior side of the shell, serves to distinguish it from another Inferior Oolite species hitherto undescribed, and for which it has not unfrequently been mistaken; the older or fully developed specimens of *Myacites gibbosus* are invariably shorter and more ventricose. The shell figured by d'Archiac represents a specimen of medium size; the *Homomya gibbosa*, Ag., 'Etud. Crit. Myes,' pl. xviii, is our *Myacites Vezelayi*, a shell which never occurs in the Inferior Oolite.

Dimensions of the small Yorkshire example. Height, 13 lines; length, 25 lines; diameter through both the valves, 11 lines.

Locality. Scarborough.

MYACITES ÆQUATUS, *Phil.* Sp. Tab. XII, fig. 15.

MYA ÆQUATA, *Phil.* Geol. York., 1, t. 11, f. 12, (junior.)

Testá ovato-tumidá, umbonibus magnis, elevatis antemedianis, latere antico producto, postico attenuato; margine superiore concavo, declivi; basi elliptico curvato.

Shell ovate, tumid; umbones large, elevated, slightly compressed, and placed anterior to the middle of the valves; anterior side produced, middle portion ventricose, posterior side rather compressed and attenuated; lower border curved elliptically; the sides of the valves have fine irregular striations. Our species possesses some general resemblance to *Pleuromya tenuistria*, Ag., but it is more lengthened, and the posterior side is more attenuated, the superior border having a greater declivity.

We believe that the small shell figured by Phillips under the name of *Mya æquata*, is the young condition of the larger specimen we have figured, in which the posterior side has with increase of growth become somewhat more elongated.

Height, 12 lines; length, 20 lines; diameter through both the valves, 10 lines.

Locality. Scarborough, in the Grey Limestone.

GRESSLYA PEREGRINA, *Phil.* Sp. Tab. XV, fig. 8a, b.

Syn. UNIO PEREGRINUS, *Phil.* Geol. York., 1, t. 7, f. 12.

GRESSLYA ERYCINA, *Ag.* Etud. Crit. Myes., p. 214, t. 14, f. 1—9.

GRESSLYA CONCENTRICA, *Ag.* Etud. Crit. Myes., p. 213, t. 14, f. 10—15.

— PEREGRINA, *Morris.* Cat. Brit. Foss., 2d ed., 1854, p. 203.

Testá ovato-cordiformi, tenui, umbonibus antemedianis subdepressis, anticè productá et

tumidá, lunulá magná, excavatá; posticè compressá, margine cardinali curvato, obliquè declivi; plicis incrementi magnis, paucis, irregularibus. Superficie granulis densè, ornatis, granulis in lineis radiantibus minutis serialibus regularibus instinctis.

Shell ovately cordiform, the test very thin, anterior side very convex and produced posterior side attenuated and compressed; umbones depressed, placed at about one third from the anterior margin, lunule large, excavated; hinge border curved and sloping obliquely downwards, its posterior extremity rounded. The sides of the valves have large irregular but distant plications.

The entire surface is very densely ornamented with minute granules disposed in closely-arranged fine radiating lines, the lines being distinctly raised and uniting the granules at their bases.

Agassiz has not noticed the *Unio peregrinus*, but his tab. XIV contains numerous and truthful exemplifications of its phases of aspect under the names of *Gresslya erycina* and *G. concentrica*.

The most prominent distinguishing feature of *Gresslya peregrina*, consists in the great development of the anterior side, and the compression of the posterior, so that when placed upon its side, the anterior border and lunule faces the spectator.

Some specimens of *Gresslya latirostris*, Ag., from the Inferior Oolite of the Cotteswolds, much resemble our species in their general outline, but the more considerable diameter through the valves upon the anterior side of *G. peregrina*, will always distinguish it, together with the more compressed and shortened figure of the posterior side.

From *Gresslya abducta* (*Unio abductus*, Phil.), it is readily distinguished by the more elevated umbones and shorter anterior side of the latter species.

Geological position and localities. *Gresslya peregrina* occurs both in the Cornbrash, and in the Grey Limestone of the Great Oolite, near Scarborough.

GONIOMYA V-SCRIPTA, Sow. Sp. Tab. XIII, fig. 16.

Syn. MYA V-SCRIPTA, Sow. Min. Con., t. 224, f. 2—5.

GONIOMYA V-SCRIPTA, Ag. Etud. Crit. Myes., t. 16, f. 17—19.

GONIOMYA V-SCRIPTA, Morris. Catal. 2d edit., 1854, p. 203.

Testá ovato-subtrigoná, umbonibus submedianis, margine antico rotundo, postico sub truncato, costis angulis acutis verticalibus, extremitate postico lævi.

Shell ovate, somewhat subtrigonal; umbones nearly mesial; anterior border rounded; posterior border somewhat truncated, lower margin nearly straight; from the umbones the anterior and posterior margins slope obliquely downwards, the posterior side, which is slightly the longer, having its slope at a smaller angle than the other; costæ numerous, their angle acute, and directly perpendicularly downwards, or a little backwards; the

posterior extremity is destitute of costæ; the costæ nearly of equal size upon both the sides of the shell.

The *Lysianassa v-scripta* of Goldfuss, Pet., t. cliv, fig. 6, is the *Mya literata* of Sowerby, Phillips, and Agassiz.

Geological position and localities. Great Oolite, Scarborough; Kelloway Rock, Wilts; Cornbrash, Bedford; Inferior Oolite, Brora; Claydon, and the Cotteswolds.

PHOLADOMYA OVALIS, Sow. Tab. XV, fig. 14.

PHOLADOMYA OVALIS, Sow. Min. Con., t. 226.

? — PELAGICA, Ag. Etud. Crit. Myes., p. 105, t. 2, f. 5—7.

— NANA, Phil. Geol. York., 1, t. 9, f. 7, (junior.)

Testâ elongato-ovatâ, anticè ventricosâ brevi, posticè elongato, angusto, vix, hiante; umbonibus magnis, elevatis; lateribus plicis longitudinalibus irregularibus et costis (circa 9) distantibus angustis, subperpendicularibus.

Shell ovately elongated; anterior side ventricose, its margin closed; posterior side attenuated and elongated, its aperture small; umbones large, elevated; superior border nearly horizontal, and sinuated, base curved elliptically; the sides of the valves with irregular longitudinal plications, crossed by costæ, which are narrow, distant (about nine in number), nearly of equal size, and are nearly perpendicular; the anterior and posterior sides are without costæ.

Of the costæ five or six are prominent, and are distinct to the lower border, the others are less elevated, and are gradually lost upon the surface. *P. pelagica*, Ag., and *P. decemcostata*, Roemer, have the costæ more oblique, but we think that the species is subject to some variability in this respect, and that they cannot be separated; *Pholadomya nana*, Phillips, we also regard as a young example of the same species; we have arrived at this conclusion from a comparison of the original specimen figured in the 'Geology of Yorkshire,' and placed at our disposal by Mr. Bean.

Height, 14 lines; length, 25 lines; diameter through both the valves, 12 lines.

Localities. The specimen forwarded to us is from the Grey Limestone of Scarborough; it also occurs in the Cornbrash of the same locality.

PHOLAS PULCHRALIS, Bean. MSS. Tab. XIII, fig. 17.

Testâ subcylindricâ, medio constricto, lateribus convexis hiantibus, costellis paucis inæqualibus radiantibus, umbonibus medianis depressis, et sulco mediano perpendiculariter instructo, lateribus semel plicis longitudinalibus subundulatis et crebris.

Shell subcylindrical, short, compressed in the middle portion, and convex towards the two extremities, each of which gapes with a considerable aperture; umbones mesial and

depressed; a narrow sulcation passes nearly perpendicularly from the umbo to the inferior border; the sides of the valves have numerous closely arranged and nearly regular but depressed plications; the plications towards the extremities are crossed by a few radiating and rather irregular costæ, which are most prominent upon the anterior side, but upon each side the costæ become indistinct which are nearest to the middle of the shell.

Lateral diameter, 13 lines; height, 9 lines.

Geological position and locality. The specimen kindly forwarded to us by Dr. Murray of Scarborough, is from the Grey Limestone of the Great Oolite.

PHOLAS COSTELLATA. Tab. XIII, fig. 18.

Testâ parvâ, ovatâ, anticè convexâ, costellatâ, posticè attenuatâ sub-lævigatâ; umbonibus magnis ante medianis, compressis; valvis in medio sulco obliquo; costellis prominentibus subacutis irregularibus; laminis concentricis crebris depressis.

Shell small, ovate; anterior side convex, with radiating, irregular, subacute costæ; posterior side nearly smooth; the middle of the valves is depressed, with a groove which passes obliquely downwards and backwards; the umbones are placed anterior to the middle of the valves, they are large and compressed; the extremities of the valves are nearly closed; the concentric lamellæ upon the sides of the shell are fine, and closely arranged, nearly disappearing upon the posterior half of the valves. The calcareous crypt, which contains the shell, is obtuse anteriorly.

Compared with *Pholas Oolitica* the costæ are more distinct and numerous upon the anterior half of the valves; the concentric lamellæ are more numerous, closely arranged, and much less conspicuous, so that they scarcely impress the radiating costæ; the mesial sulcus is more oblique, and the general figure of the shell is less cylindrical; the crypt is less ovate, or more nearly pyriform, the anterior extremity being more obtuse. The posterior extremity of the shell is somewhat embedded in the crypt, and is not sufficiently exposed to enable us to give the dimensions with accuracy; the costæ upon the anterior half are about 12 in number, and nearly straight; the anterior extremity does not exhibit any distinct apertures.

Locality. Scarborough.

CEROMYA CONCENTRICA. Tab. XV, fig. 3, *antea*, p. 108.

GERVILLIA ACUTA. Tab. XIV, fig. 1, 1a, *antea*, p. 20.

Trigonia conjungens is probably a variety of *T. angulata*.

NOTE.—We are indebted to the liberality of Mr. J. Leckenby and Mr. W. Bean, of Scarborough, for the loan of the specimens above described from the Oolite of Yorkshire.

ADDENDA.

PHOLADOMYA OBLITA. Tab. XII, fig. 5.

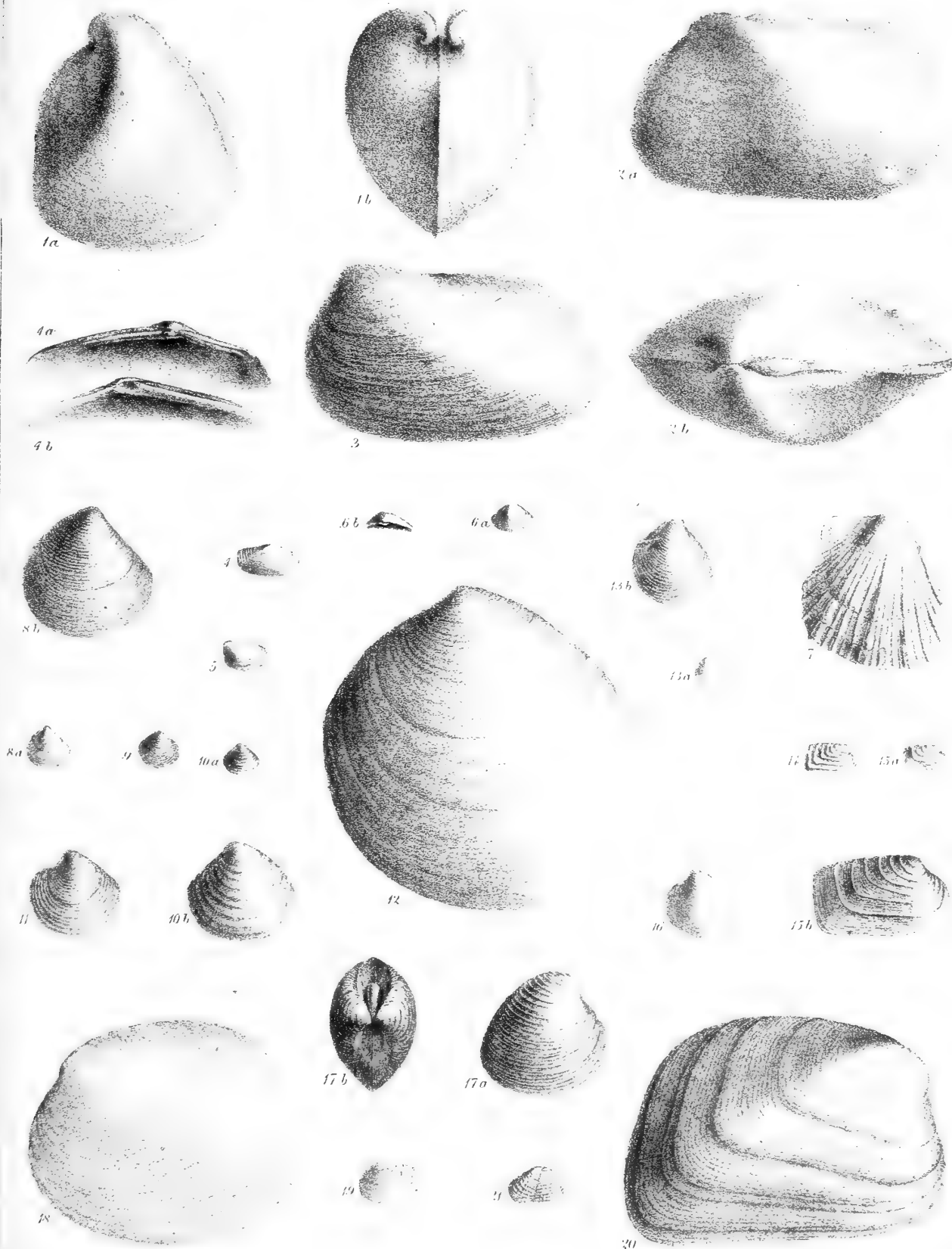
Shell ovately ventricose, umbones large, elevated; anterior side tumid, posterior side produced, compressed, its extremity gaping with a narrow aperture; superior border concave, inferior border curved elliptically; sides of the shell with very numerous, fine radiating lines, which are effaced towards the lower borders, and are absent towards the two lateral extremities.

The shell which most nearly resembles the present species is the well known *Pholadomya fidicula*, Sow., from which it is distinguished by the shorter and more ventricose figure, by the much larger and more elevated umbones, by the considerable curvature of the lower border, and by the surface, which, in lieu of the acute elevated costæ of *P. fidicula*, has very much more numerous, fine, lines, which vanish towards the lower border. *Pholadomya oblita* has occurred rarely in sandstone at the base of the Great Oolite, and also in the Inferior Oolite of the Cotteswolds.

Localities. Minchinhampton Common, in the Great Oolite. Selsley and Frocester hills, in the Inferior Oolite.

TAB. IX.

Fig.	
1 <i>a, b.</i>	<i>Ceromya undulata</i> , p. 106.
2 <i>a, b.</i>	<i>Myacites tumidus</i> , p. 117.
3.	<i>Myacites crassiusculus</i> , p. 112.
4.	<i>Quenstedtia oblita</i> , p. 96.
4 <i>a, b.</i>	Hinge of ditto.
5.	<i>Nucula variabilis</i> , p. 51.
6.	<i>Corbula involuta</i> , p. 97.
7.	<i>Hinnites abjectus</i> , p. 125.
8 <i>a, b.</i>	<i>Astarte excentrica</i> , p. 83.
9.	„ <i>squamula</i> , p. 82.
10 <i>a, b.</i>	„ <i>minima</i> , p. 82.
11.	„ <i>depressa</i> , p. 85.
12.	„ <i>rotunda</i> , p. 84.
13 <i>a, b.</i>	„ <i>pumila</i> , p. 83.
14, 15 <i>a, b.</i>	„ <i>interlineata</i> , p. 87.
16.	„ <i>Wiltonii</i> , p. 87.
17 <i>a, b.</i>	„ <i>angulata</i> , p. 86.
18, 19.	„ <i>excavata var. compressiuscula</i> , p. 85.
20.	„ <i>rhomboidalis</i> , p. 84.
21.	<i>Pholas Oolitica</i> , p. 126.



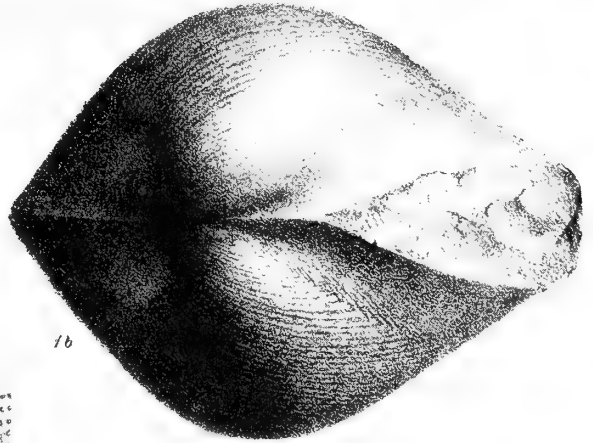
TAB. X.

Fig.

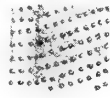
- 1*a, b.* *Ceromya plicata*, p. 107.
- 2. ditto. p. 107.
- 3*a, b.* *Ceromya concentrica*, p. 108.
- 4*a, b.* *Ceromya Symondsii*, p. 106.
- 5*a, b.* *Myacites dilatus*, p. 114.
- 6. *Myacites unioniformis*, p. 115.
- 7. *Gresslya peregrina, var.*, p. 105.



1a



1b



5c



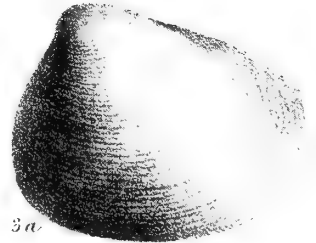
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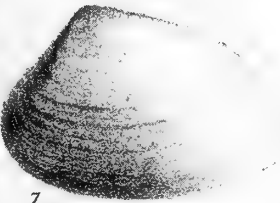
5b



5a



3a



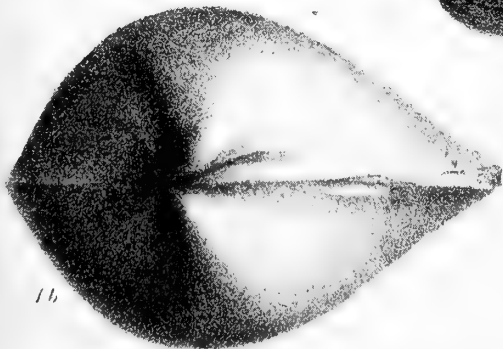
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3b



6



1b

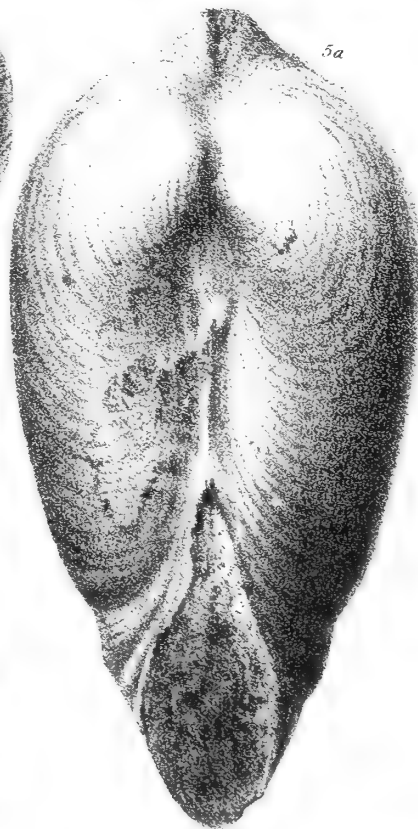
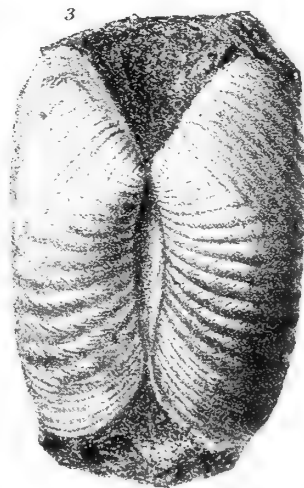
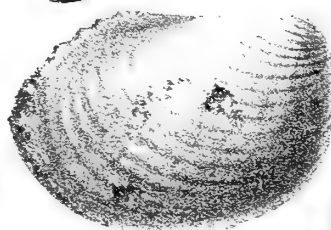
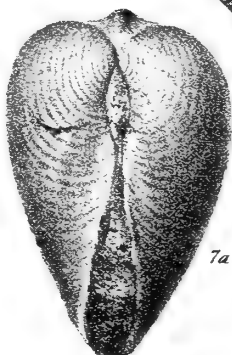
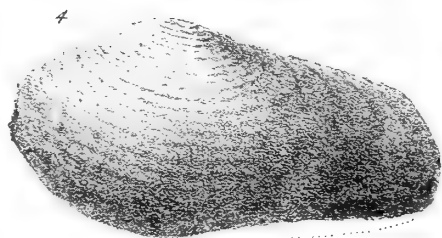
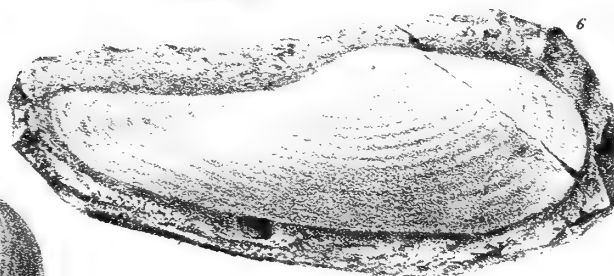
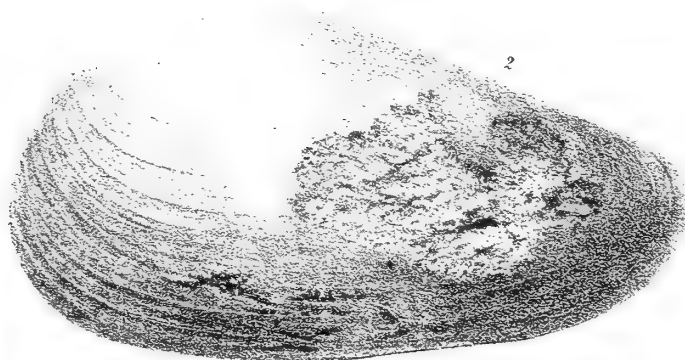
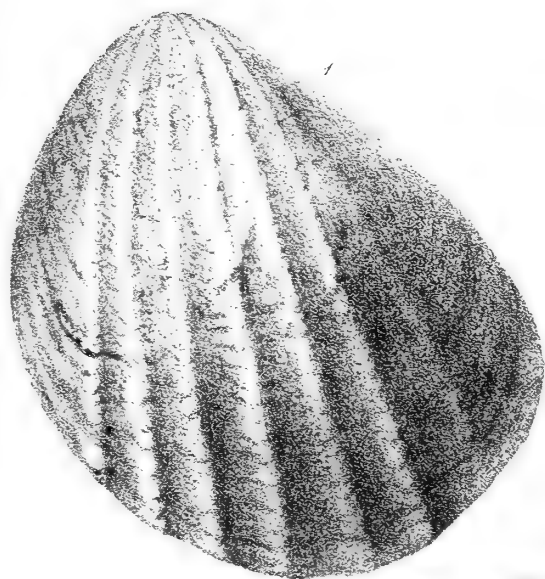


4a

TAB. XI.

Fig.

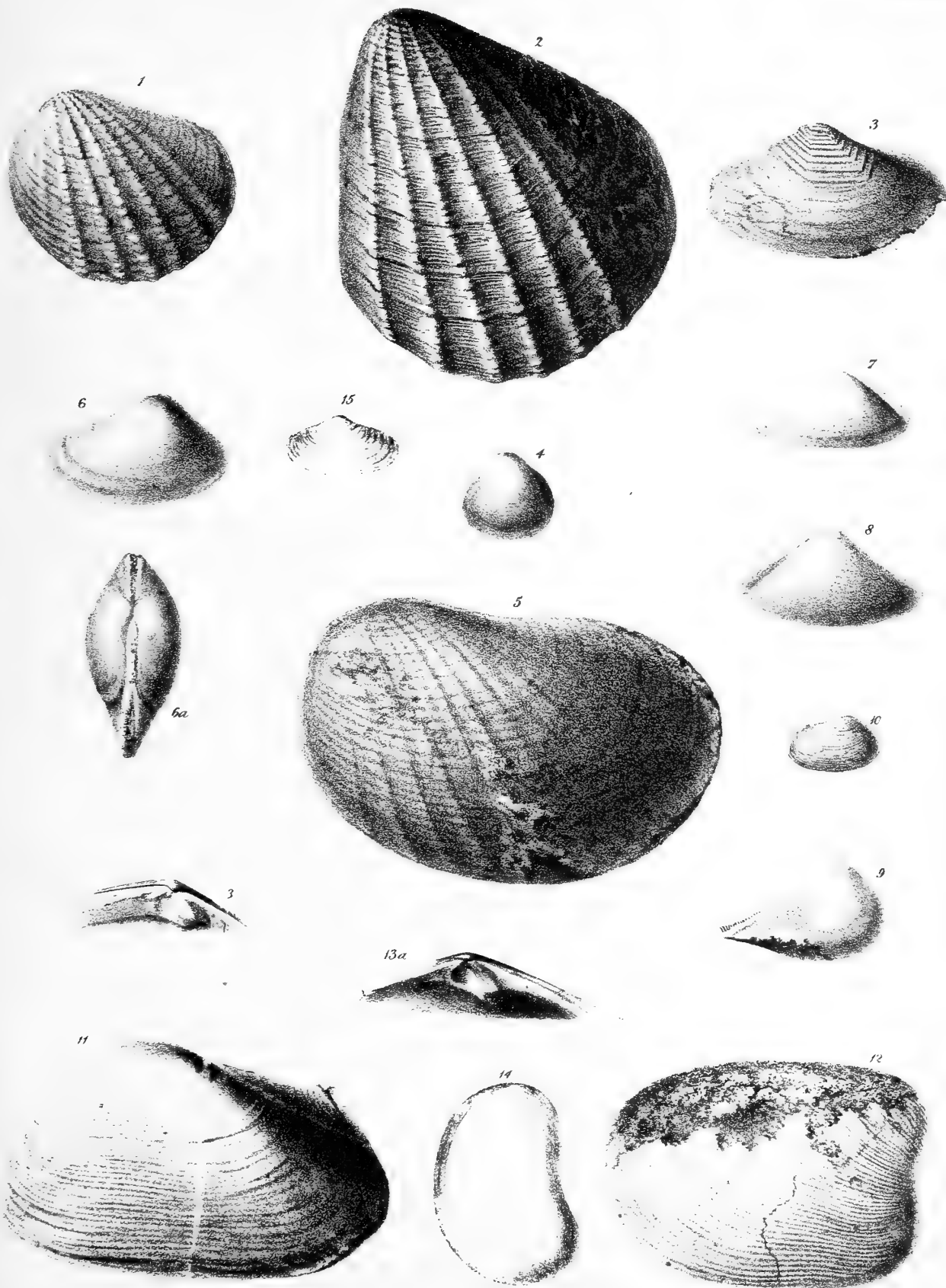
1. *Pholadomya solitaria*, p. 123.
2. *Myacites calceiformis*, p. 113.
3. *Goniomya literata*, p. 119.
4. *Anatina undulata*, p. 188.
- 5, 5*a*. *Myacites Vezelayi*, p. 111.
- 6, 6*a*. *Anatina plicatella*, p. 118.
- 7, 7*a*. *Pholadomya socialis*, p. 122.



TAB. XII.

Fig.

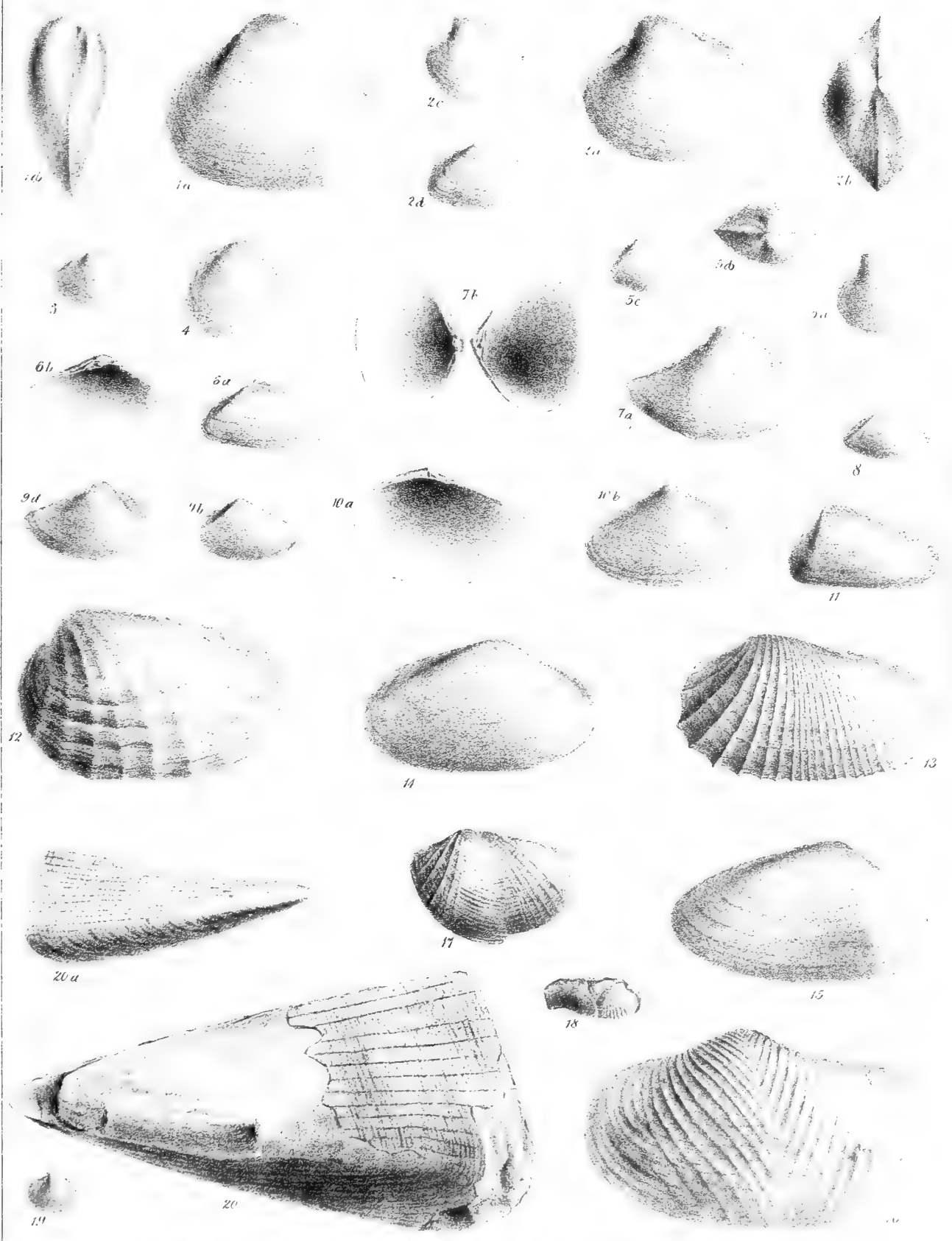
1. *Pholadomya Heraulti*, p. 124.
2. *Pholadomya oblita*, p. 243.
3. *Goniomya hemicostata*, p. 120.
4. *Cyprina nuciformis*, p. 90.
5. *Pholadomya oblita*, p. 143.
6. *Myacites Terquemea*, p. 115.
7. *Tancredia axiniformis*, p. 93.
8. *Tancredia angulata*, p. 94.
9. *Neæra Ibbetsoni*, p. 98.
10. *Astarte recondita*, p. 88.
11. *Myacites compressus*, p. 116.
12. *Ceromya similis*, p. 109.
14. *Myacites gibbosus*, p. 138.
15. *Myacites æquatus*, p. 139.



TAB. XIII.

Fig.

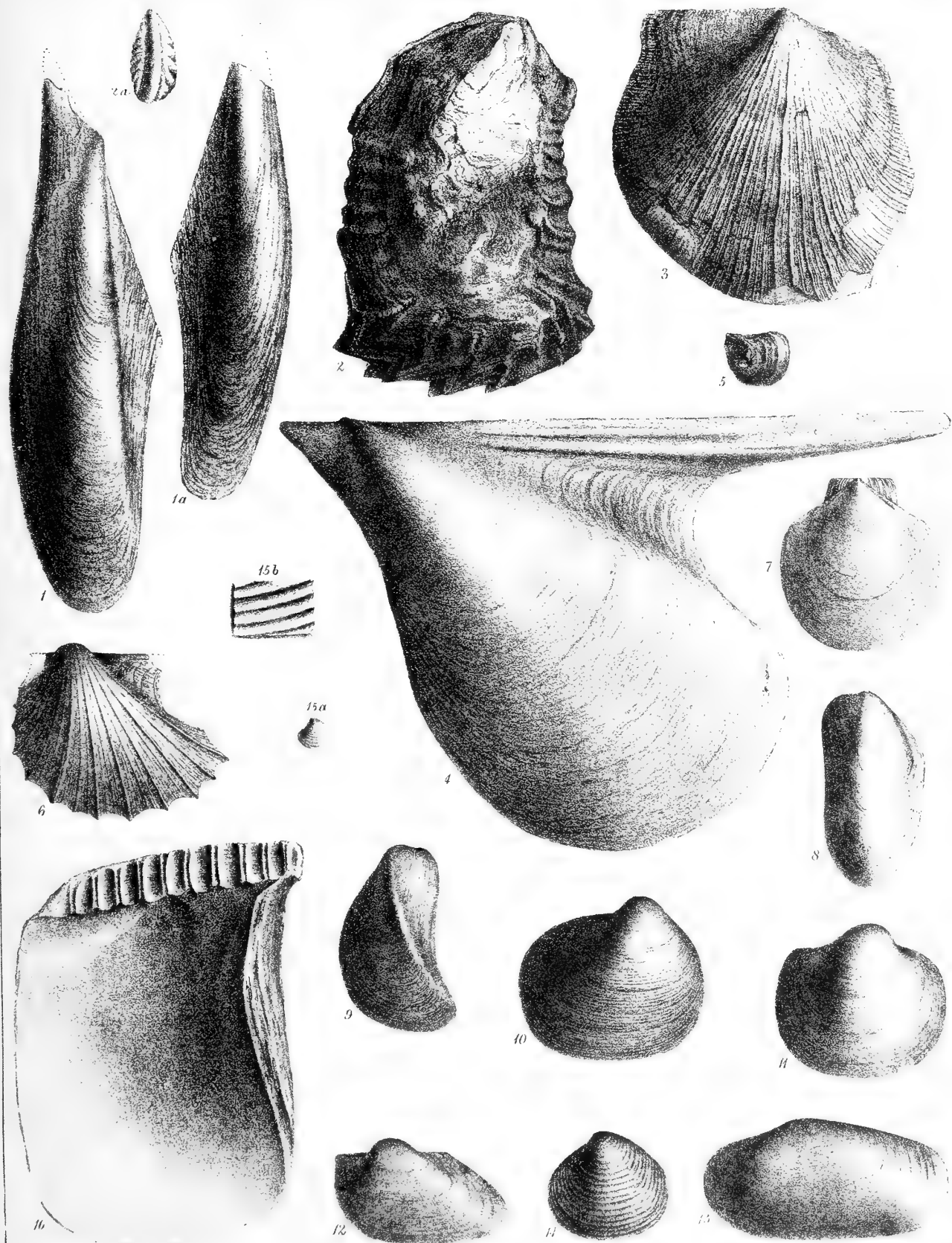
- 1, 1*a*, *b*. *Thracia curtansata*, p. 110.
- 2, 2*a*, *c*. *Cyprina Loweana*, p. 88.
- 2*d*. „ „ *var. elongata*.
3. *Cyprina Jurensis*, p. 89.
4. *Cyprina depressiuscula*, p. 90.
- 5, 5*a*, *b*, *c*. *Cyprina trapeziformis*, p. 89.
- 6*a*. *Tancredia axiniformis*, p. 93.
- 6*b*. Hinge of ditto.
- 7*a*. *Tancredia curtansata*, p. 93.
- 7*b*. Hinge of ditto.
8. *Tancredia brevis*, p. 92.
- 9*a*, *b*. *Tancredia angulata*, p. 94.
- 10*a*, *Tancredia planata*, p. 94.
- 10*b*, Hinge of ditto.
11. *Tancredia truncata*, p. 92.
12. *Pholadomya ovulum*, p. 122.
13. *Pholadomya acuticosta*, p. 121.
14. *Corbis (Corbicella) Bathonica*, p. 95.
15. *Myacites securiformis*, p. 136.
16. *Goniomya V-scripta*, p. 139.
17. *Pholas pulchralis*, p. 140.
18. *Pholas Oolitica*, p. 140.
19. *Cyprina dolabra*, p. 135.
- 20*a*, *b*. *Pinna cancellata*, p. 130.



TAB. XIV.

Fig.

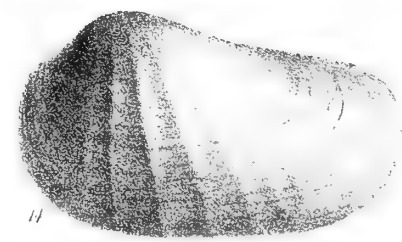
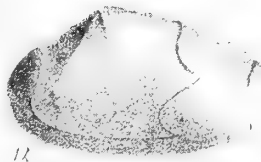
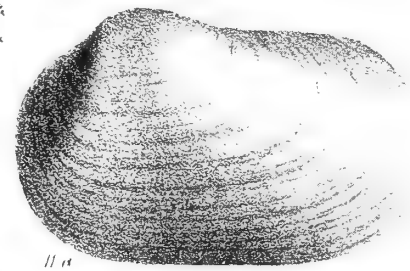
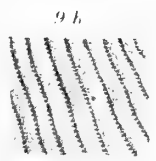
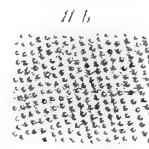
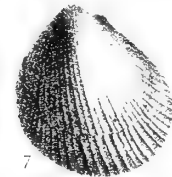
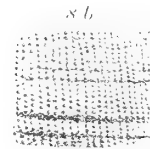
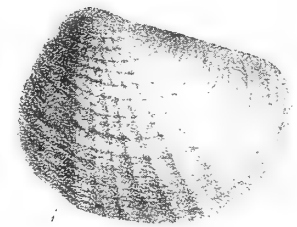
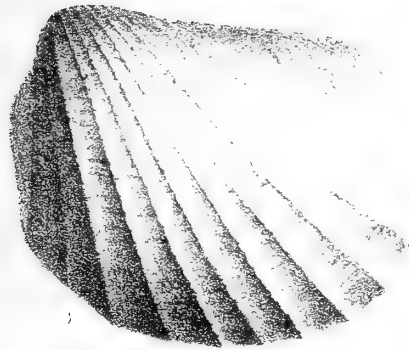
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CORRIGENDA.

- Part I, p. 27, *for* "Purpuroidea Moreausia," *read* "P. Morrisii, Buv.;" *Purpura* Moreausia, is considered by M. Buvignier to be a distinct species.
- p. 48, *for* "Eulima pygmæa," *read* "Eulima vagans (junior)."
- p. 93, *for* "Patella nana," *read* "Patella cingulata (junior)."
- Part II, p. 24, *for* "Inoceramus Fittoni, Tab. iv," *read* "Tab. iii."
- p. 48, sixth line from the bottom, erase the four words within the parenthesis.
- p. 49, second line, erase the last three words. The raised ledge which supports the *anterior* muscular impression in *Macrodon* separates it from other sub-genera of *Arca*; in *Cucullæa* the ledge is *posterior*.
- p. 75. Both *Cypricardi. Bathonica*, d'Orb. and *C. cordiformis*, Desh., occur in the Inferior Oolite of the Cotteswolds but in different beds, further observations have induced us to regard them as only varieties of the same species induced by peculiarities of the beds in which they occur.

THE

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A MONOGRAPH

OF THE

BRITISH FOSSIL CORALS.

BY

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COPENHAGEN, VIENNA, KONIGSBERG, MOSCOW, BRUXELLES, HAARLEM, BOSTON, PHILADELPHIA, ETC.,

AND

JULES HAIME.

FIFTH PART.

CORALS FROM THE SILURIAN FORMATION.

LONDON:

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DESCRIPTION OF THE BRITISH FOSSIL CORALS.

CHAPTER XVI.

CORALS FROM THE SILURIAN FORMATION.

AT no period of the geological history do Polypi appear to have been more abundant, and to have constituted as important a portion of the marine fauna, as at the time during which the Silurian deposits were formed. The variety of species is here as considerable as in most of the richest coralliferous rocks of a more recent date, and the number of specimens is usually greater. But what contributes still more to the importance of the study of the Silurian corals, is the good state of preservation in which they are generally found. The environs of Dudley were long ago, and still are, celebrated for their numerous fossil corals, as well as for the abundance of their trilobites; of late years many other localities, equally rich in palæontological treasures, have been explored in various parts of Great Britain; and, at the present day, more than half of the species discovered in the Silurian deposits of the new as well as of the old world, have been found in England. This result is principally due to the indefatigable researches of Sir Roderick Murchison and his followers. The British Silurian fossils found by that able and justly-celebrated geologist, were described and figured in his standard work by Mr. Lonsdale, who referred most of them to the species previously described by Goldfuss, and found by that naturalist in the Devonian deposits of the Eifel Mountains in Germany. This supposed identity, however, does not exist in any of the well-characterised species. The specimens figured by Mr. Lonsdale in Sir R. Murchison's work, have been communicated to us for examination by the Council of the Geological Society of London, and on comparing them with the specimens figured by Goldfuss, and placed by that author in the Poppelsdorf Museum at Bonn, we have been able to ascertain that almost all of them are specifically different. M. D'Orbigny, without having had an opportunity of making any such direct comparison, came at the same time to a similar conclusion; and the researches of Professors Sedgwick and M'Coy fully confirm this result.

The British Silurian corals differ but little from those of Gothland, and resemble also very much those (in small number) that have been met with in the corresponding rocks of Bohemia, but are generally distinct from those of the Silurian deposits of North America. The total number of species discovered in the various Silurian deposits amounts to 129, and with the exception of 8, they all belong to our divisions of *Zoantharia tabulata* and *Zo. rugosa*; one of which zoological forms is comparatively rare in the present time, and the other belongs exclusively to the palæozoic period. Seventy-six of these corals are found in England, and about half of these have not been met with elsewhere. Most of these British fossils (sixty-eight species) belong to the families of Favositidæ and Cyathophyllidæ; and the only species not appertaining to the above-mentioned higher divisions are four Fungidæ.

The principal palæontological collections, from which we have obtained the specimens studied and described in this chapter, are those of the Geological Society of London, of the Museum of Practical Geology, of Mr. Fletcher (Dudley), of Mr. John Gray (Dudley), of Mr. Bowerbank, Mr. Charles Stokes (London), of M. Bouchard-Chantreaux (Boulogne-sur-Mer), of M. de Verneuil, and of the Museum of Natural History of Paris.

Most of these corals belong to the upper Silurian rocks, and those found in the lower Silurian deposits are in general very ill preserved and unsatisfactorily characterised. We, therefore, have not deemed it necessary to devote a separate chapter to their description.

Family FUNGIDÆ, (*Introd.*, p. xlv.)

Genus PALÆOCYCLUS, (*Introd.*, p. xlvi.)

1. PALÆOCYCLUS PORPITA. Tab. LVII, figs. 1, 1a, 1b, 1c.

FOSSILE QUERFURTENSE, *D. S. Buttners*, Coralogr. Subterr., p. 25, tab. iii, fig. 5, 1714.

FUNGITARUM CAPITULA, PARVA, STRIATA, &c., *Magnus Bromel*, Acta Liter. Suec., vol. ii, p. 446, figs. a—h, 1728.

MADREFORA SIMPLEX, ORBICULARIS, &c., *Fougt*, Amæn. Acad., t. i, p. 91, tab. iv, fig. 5, 1749.

MADREFORA PORPITA, *Linné*, Syst. Nat., edit. xii, p. 1272, 1767.

CYCLOLITES NUMISMALIS, *Lamarck*, Syst. des Anim. sans Vert., p. 369, 1801.

PORPITES HEMISPHERICUS, *Schlotheim*, Petrefactenkunde, 1st part, p. 349, 1820.

MADREPORITES PORPITA, *G. Wahlenberg*, Nov. Act. Reg. Societ. Scient. Upsal., vol. viii, p. 95, 1821.

CYCLOLITES NUMISMALIS, *Hisinger*, Leth. Suec., p. 100, tab. xxviii, fig. 5, 1837.

PALÆOCYCLUS PORPITA, *Milne Edwards* and *Jules Haime*, *Introd.*, p. xlvi, 1850.—*Polyp. Foss. des Terr. Palæoz.* (Arch. du Mus., vol. v.), p. 204, 1851.—*Ann. des. Sc. Nat.*, 3d ser., vol. xv, p. 110, 1851.

Corallum discoidal; its under surface flat, covered with a strong epitheca, presenting concentrical wrinkles, and completely free, or provided with a conical, curved, flat

peduncle. The upper surface much depressed towards the centre, and surrounded by a thick rim formed by prominent septa. The *columella* (if existing) very short and imperfectly formed. Large septa (28 or 30), uniformly developed, and alternating with smaller ones; they probably form six systems, four of which are composed of seven elements, and two of eleven derivated septa; or, in other words, they appear to constitute four complete cycles, to which septa of a fifth cycle are superadded in one half of two or three systems, in which the quaternary septa have also attained a greater size. All these septa are thick, very closely set externally, and quite straight, the upper edge of the principal ones is regularly convex, and armed with closely-set, strong teeth or crenulations; two rows of these small points often exist on the same septum, towards the exterior part of the corallum. Diameter, in general, 5 or 6 lines; height about 1 line.

Dudley. It is also met with in Gothland.

Specimens are in the Collections of Mr. T. W. Fletcher, and of Mr. J. Gray, at Dudley, of the Museum of Practical Geology, London; of M. de Verneuil, at Paris, &c.

This species differs from *P. Fletcheri*,¹ and *P. rugosus*,² by its extremely flat form. *P. præacutus*³ is also discoidal, but all its septa are equally developed, whereas, in *P. porpita*, there are alternately large and small septa.

2. PALÆOCYCLUS PRÆACUTUS. Tab. LVII, figs. 2, 2a, 2b, 2c.

CYCLOLITES PRÆACUTA, *Lonsdale*, in Murchison, *Silur.* Sv., p. 693, tab. xix, fig. 4, 1839.

CYCLOLITES LENTICULATA, *Ibid.*, p. 693, tab. xv, fig. 5 (but not *Porpites lenticulatus* of Schlotheim).

CYCLOLITES PRÆACUTUS, *Eichwald*, *Silur. Schisten Syst.*, p. 201, 1840.

DISCOPHYLLUM PRÆACUTUM and LENTICULATUM, *D'Orbigny*, *Prodr. de Paleont.*, vol. i, p. 47, 1850.

PALÆOCYCLUS PRÆACUTUS, *Milne Edwards* and *Jules Haime*, *Pol. Foss. des Terr. Palæoz.* (*Arch. du Mus.*, vol. v), p. 205, 1851.—*Ann. des Sc. Nat.*, 3d ser., vol. xv, p. 110, 1851.

The only specimens of this species that we have seen, are those described by M. Lonsdale, and belonging to the Collection of the Geological Society of London. They are cycloлитoid coralla, much resembling *P. porpita* by their general form, but thinner. Their under surface is almost flat; sometimes it is slightly prominent in the centre, but never presents any appearance of a peduncle, and is covered with a somewhat thin, delicately-wrinkled epitheca. Septa 48 in number, not much elevated, regularly crenulated, and not appearing to alternate with smaller ones. Diameter of a large individual, about 8 lines; height about 1 line.

Found at Marloes Bay, Pembrokeshire.

¹ See tab. lvii, fig. 3.

² See tab. lvii, fig. 4.

³ See tab. lvii, fig. 2.

This species is of a more regular discoidal form than any others of the same genus. *P. porpita*,¹ which is also very flat, differs from it by the septa being alternately large and small.

3. *PALÆOCYCLUS FLETCHERI*. Tab. LVII, figs. 3, 3*a*, 3*b*, 3*c*, 3*d*, 3*e*, 3*f*.

PALÆOCYCLUS FLETCHERI, *Milne Edwards* and *Jules Haime*, *Pal. Foss. des Terr. Palæoz.* (*Arch. du Mus.*, vol. v), p. 205, 1851.—*Ann. des Sc. Nat.*, 3d ser., vol. xv, p. 111, 1851.

Corallum very short, but of a subturbinate form, with a short, strongly curved peduncle, a thick epitheca, and some well developed accretion wrinkles. *Calice* circular, or almost so, with a somewhat deep cavity, and a lamellated edge. 36 or 38 principal septa, alternating with an equal number of small ones; somewhat thick, closely set, not tall, and scarcely exsert; their edge slightly convex, and provided with rather strong denticulations, which, closely set exteriorly, become more distant towards the centre, and scarcely ever form a double row on the same septum. Diameter of the calice about 8 lines; height of the corallum about 4 lines.

In the young specimens the peduncle is more developed proportionally. In an aged individual, that measured almost 12 lines in diameter, and that does not appear to differ specifically from the former, the marginal denticulations of the principal septa are almost obsolete exteriorly.

Dudley. Collections of Mr. T. W. Fletcher, and of M. Bouchard-Chantreaux (Boulogne).

By its general form, this species is intermediate between *P. porpita*² and *P. rugosus*,³ its septa are also more numerous and more strongly denticulated than in either of these fossils.

4. *PALÆOCYCLUS RUGOSUS*. Tab. LVII, figs. 4, 4*a*, 4*b*, 4*c*, 4*d*.

PALÆOCYCLUS RUGOSUS, *Milne Edwards* and *Jules Haime*, *Pol. Foss. des Terr. Palæoz.* (*Arch. du Mus.*, vol. v), p. 206, 1851.—*Ann. des Sciences Nat.*, 3d ser., vol. xv, p. 111, 1851.

Corallum cylindro-turbinate, sometimes rather elongate; its basis subpedunculated, much bent, and compressed; *epitheca* thick, and presenting strongly developed accretion wrinkles, which are very oblique near the basis. *Calice* circular, with a large, and somewhat deep cavity. Principal septa (26 or 28) alternating with an equal number of small ones; somewhat thick, with their edges regularly denticulated, and slightly arched interiorly. The

¹ See tab. lvii, fig. 1.

² See tab. lvii, fig. 1.

³ See tab. lvii, fig. 4.

large specimens are about 4 or 5 lines in diameter, and somewhat more in height ; the young ones are almost as broad, but scarcely more than half as high.

Found at Dudley and at Wenlock. Specimens in the Collections of Mr. Fletcher, of the Geological Society of London, of the Parisian Museum, &c.

This coral is much taller than the preceding species of the same genus, and its septa are thinner and less strongly denticulated. By its exterior characters it resembles very much the young specimens of *Cyathophyllum*, but its internal structure renders it quite distinct.

Family MILLEPORIDÆ, (p. lviii.)

1. Genus HELIOLITES, (p. lviii.)

1. HELIOLITES INTERSTINCTA. Tab. LVII, figs. 9, 9a, 9b, 9c, 9d.

MILLEPORA SUBROTUNDA, &c., *Foug.*, Amæn. Acad., vol. i, p. 99, tab. iv, fig. 24, 1749.

MADREPORA INTERSTINCTA, *Linné*, Syst. Nat., ed. 12, p. 1276, 1767.

PORPITAL MADREPORITE, *Parkinson*, Org. Rem., vol. ii, pl. vii, fig. 2—5, 1808.

MADREPORITES INTERSTINCTUS, *Wahlenberg*, Nov. Acta Soc. Scient. Upsal., vol. viii, p. 98, 1821.

SARCINULA PUNCTATA, *Fleming*, Brit. Anim., p. 508, 1828.

— — *S. Woodward*, Syn. Table of Brit. Org. Rem., p. 5, 1850.

ASTRÆA CORONA, *Ch. Morren*, Descr. Cor. Belg., p. 64, tab. xxi, figs. 1, 2, 1832.

ASTREA POROSA, *Hisinger*, Leth. Suec., p. 98, tab. xxviii, fig. 2, 1837. (Not *Goldfuss*.)

PORITES PYRIFORMIS, *Lonsdale*, Silur. Syst., p. 686, pl. xvi, figs. 2, 2a, 2b, 2c (cæt. excl.), 1839.

HELIOPORA INTERSTINCTA, *Eichwald*, Sil. Schist. Syst. in Esthland, p. 199, 1840.

PORITES PYRIFORMIS, *Lonsdale*, Russ. and Ural, vol. i, p. 625, 1845.

PORITES INTERSTINCTA, *Keyserling*, Wiss. Beob. auf ein Reise in das Petschora Land, p. 175, 1846.

GEOPORITES LONSDALEI, PYRIFORMIS, and INTERSTINCTA, *D'Orbigny*, Prodr. de Paleont., vol. i, pp. 49, 50, 1850.

PALÆOPORA INTERSTINCTA, *M'Coy*, Brit. Palæoz. Foss., p. 15, 1851.

HELIOLITES INTERSTINCTA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 214, 1851.

HELIOLITES PYRIFORMIS, *Hall*, Paleont. of New York, vol. ii, p. 133, pl. xxxvi A, fig. 1, 1852.

Corallum composite, massive, in general more or less round or gibbose, sometimes subdendroid. *Calices* closely set (at a distance equal only to their diameter or to two thirds of it), and of the same size in the different parts of the same compound specimen ; their edge circular, and slightly prominent ; in well preserved specimens a small columellary elevation is visible on the surface of the uppermost tabula ; 12 septa, somewhat unequal in size alternately. Polygonal divisions of the cœnenchyma regular

and of equal size; their diameter about one eighth of a line. Diameter of the calices about two thirds of a line.

This species has been found in the inferior Silurian beds at Applethwaite and Caradoc. Sir R. Murchison has found it also at Marloes Bay, in Pembrokeshire. It exists also in the upper Silurian deposits at Wenlock and Dudley; and in Ireland. The British localities mentioned by Sir R. Murchison as presenting this fossil, are—Aymestry, Rutter Edge, Wenlock Edge, Lincoln Hill, Benthall Edge, Haven near Aymestry, Lindell's Park, the Ledbury, Delves Green, and Walsall. Professor M'Coy points out its existence in the Coniston limestone of Long Steddale, Westmoreland; and in Galway, Kerry, Mayo, and Dublin. It is also met with at Nehou and Viré, in France; in Gothland, in Russia, and in North America. Mr. Hall has recently found it in the Niagara limestone at Lockport, and at Milwaukee, Wisconsin.

H. interstincta much resembles *H. porosa*,¹ with which many authors have confounded it; but it differs from that species by the calices being much more closely set, and by the polygonal divisions of the cœnenchyma being proportionally much smaller.

We are inclined to think that the fossil corals which Professor M'Coy mentions as being extremely abundant in the calcareous schists and limestone of Craig Head, Ayrshire; Girvan; and in the fine Caradoc limestone of Mulock Quarry, Dalquorhan, Ayrshire, and designates under the name of *Palæopora favosa*,² are ill-preserved specimens of the above-described species.

2. HELIOLITES MURCHISONI. Tab. LVII, figs. 6, 6a, 6b, 6c.

FUNGITES, *Thomas Pennant*, Philos. Trans., vol. xlix, 2d part, p. 513, tab. xv, fig. 2, 1757.

COMPOUND MADREPORITE, *Parkinson*, Org. Rem. of a Form. World, vol. ii, pl. vii, fig. 10, 1808.

PALEOPORA INTERSTINCTA, var. SUBTUBULATA, *M'Coy*, Brit. Palæoz. Foss., p. 16, pl. i c, fig. 2, 1851.

HELIOLITES MURCHISONI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 215, 1851.

Corallum composite, massive, irregularly circular; its upper surface convex, and its under surface in general free, and presenting strongly-marked circular rugose ridges. *Calices* equally developed in the same specimen, and varying but little in size in different specimens; about half a line in diameter; their margin very thin, and scarcely exsert, but quite distinct from the surrounding cœnenchyma; and in some of the well-preserved corallites, 12 small septa, somewhat unequally developed alternately, are visible. The calices are not closely set, and vary in their degree of approximation; the space between

¹ See tab. xlvii, fig. 1.

² British Palæoz. Fossils, p. 15, tab. i c, fig. 15.—Ann. and Mag. of Nat. Hist., 2d series, vol. vi, p. 285 (1850).

them being, in general, equal to twice, and sometimes to thrice their diameter. The polygonal divisions of the cœnenchyma are very regular in form and in size; their breadth is about half of a line.

A vertical section of this fossil shows that the walls are very distinct, and the tabulæ closely set, and in general placed horizontally, but sometimes slightly oblique. The appearance of the cœnenchyma differs in the upper and lower parts of the corallum; near the upper surface, to the depth of about 1 line, the vertical lines corresponding to the section of the prismatical lamina of the tubes, are much more strongly marked than the horizontal lines that correspond to the sections of the trabiculæ or small intratrabicular diaphragms; but in the lower parts of the corallum a contrary disposition exists, and the transversal lines running nearly parallel to the surface of the compound mass, are the only ones which are distinct to the naked eye.

H. Murchisoni is found in the upper Silurian deposits of Wenlock Edge. Professor M'Coy has met with it at Aymestry, in Herefordshire; at Coniston Waterhead, in Lancashire; and at Llansantfraid, in Denbighshire. It is found also in Gothland.

Specimens are in the Collections of the Parisian Museum, of the Museum of Practical Geology of London, of M. de Verneuil, and M. Michelin.

This fossil coral differs from *H. interstincta*¹ by the greater distance between the calices, and the abundance of the cœnenchyma. It much resembles *H. porosa*² by its external characters, but differs from it by the structure of its cœnenchyma; the horizontal laminae of that tissue being much more developed than the vertical ones, whereas the contrary takes place in *H. porosa*.

3. HELIOLITES MEGASTOMA. Tab. LVIII, figs. 2, 2a, 2b, 2c, 2d.

PORITES PYRIFORMIS (pars), *Lonsdale*, in Murchison, Silur. Syst., p. 686, pl. xvi, figs. 2d, 2e (cæt. excl.), 1839.

PORITES MEGASTOMA, *M'Coy*, Silur. Foss. of Irel., p. 62, pl. iv, fig. 19, 1846.

GEOPORITES INTERMEDIA, *D'Orbigny*, Prodr. de Pal., vol. i, p. 49, 1850.

PALÆOPORA MEGASTOMA, *M'Coy*, Brit. Palæoz. Foss., p. 16, pl. i c, fig. 4, 1851.

HELIOLITES MEGASTOMA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 216, 1851.

HELIOLITES MACROSTYLUS, *J. Hall*, Paleont. of New York, vol. ii, p. 135, pl. xxxvi A, fig. 2, 1852.

Corallum composite, massive, irregularly hemispherical; sometimes adherent, sometimes free. Epitheca of the under surface not much developed. *Calices* having all nearly the same dimensions in the same specimen, but varying from two thirds of a line to $1\frac{1}{4}$ line in different specimens; very closely set, quite circular, and with a margin not prominent, and scarcely

¹ See tab. lvii, fig. 5.

² See tab. xlvii, fig. 1.

discernible from the surrounding *cœnenchyma*. Septa 12 in number, but little developed, rather slender, and slightly unequal in size alternately.

A vertical section shows that the visceral chamber of each corallite is limited by a thin, but well-characterised *wall*, and is divided by numerous closely-set, well-developed *tabulæ*, that are almost all quite horizontal. The continuation of the vertical septa is often visible in the space comprised between the *tabulæ*. The *cœnenchyma* is entirely made up with small square cells, formed by the parieties of the vertical canaliculæ, and the horizontal dissepiments meeting at right angles. In some parts of the corallum all those small horizontal diaphragms comprised between two adjoining corallites are placed on the same level, and correspond exactly; in other parts they alternate more or less completely; but in no instance do these intratrabicular dissepiments correspond with the intramural *tabulæ*.

Found in the lower Silurian deposits at Coniston, and in the upper Silurian beds at Wenlock Edge. Professor M'Coy mentions its existence at Mathyrafal, Montgomeryshire; High Haume, Dalton in Furness, Lancashire; Blayn y Cwm, West of Nantyre, Glyn Ceiriog; and Egool, Bellaghadereen, Mayo. A variety of the same species has been met with by that geologist in the Bala limestone of Maes Meillion, south of Bala, Merionethshire. Mr. Hall has also found it in the Niagara limestone, at Milwaukie, in Wisconsin. Some corals from the Devonian deposits of Nehou, in Normandy, do not appear to differ specifically from the former.

Specimens are in the Collections of the Museum of Practical Geology, of the Geological Society, of the Bristol Museum, the Parisian Museum, &c.

H. megastoma is easily recognised by its large and closely-set calices, and by the slight development of the *cœnenchyma*.

4. HELIOLITES GRAYI. Tab. LVIII, figs. 1, 1a.

HELIOLITES GRAYI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 217, 1851.

Corallum composite, dendroidal, forming lamellar sublobated expansions, both surfaces of which bear *calices*. These are placed at various distances from each other (one, two, or three times their diameter), and are limited by a small, well-marked, circular ridge, formed by the exsert edge of 12 subequal thick *septa*. The canaliculæ of the *cœnenchyma* are somewhat irregular, and their parieties are rather thick. Diameter of the calices about one third of a line.

This fine fossil was found in the upper Silurian beds at Walsall, and belongs to the Collection of Mr. J. Gray, of Dudley.

The remarkable frondescent form of this fossil is met with in no other species of the

same genus. In most other respects *H. Grayi* much resembles *H. Murchisoni*¹ and *H. inordinata*,² but may be distinguished from both by the circular exsert margin of the calices.

The fossil figured in M. Murchison's justly-celebrated work under the name of *BLUMENBACHIUM GLOBOSUM* Lonsdale,³ appears to be a mould of a coral belonging to the above-described species. It was found at Wenlock.

5. HELIOLITES INORDINATA. Tab. LVII, figs. 7, 7a.

PORITES INORDINATA, Lonsdale, in Murchison, Silur. Syst., p. 687, pl. xvi bis, fig. 12, 1839.

LONSDALIA INORDINATA, D'Orbigny, Prodr. de Paléont., vol. i, p. 25, 1850.

PALÆOPORA SUBTILIS? M'Coy, Brit. Palæoz. Foss., p. 17, 1851.

HELIOLITES INORDINATA, Milne Edwards and Jules Haime, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 217, 1851.

Corallum arborescent, very ramous; its branches slender, subcylindrical, and about one or one and a half line in diameter. *Calices* not prominent, circular, or somewhat elongated in the longitudinal direction of the branches, and set at various distances from each other in different parts of the corallum. *Septa* 12 in number, nearly similar in size, rather thick, and well developed. Cells of the *cœnenchyma* polygonal and somewhat irregular. Diameter of the calices about half a line.

Found in the lower Silurian beds at Robeston Walthen, Pembrokeshire. According to Professor M'Coy it exists also in the upper Silurian deposits at Ferriter's Cove, Doonquin, and Dingle, in Kerry. The fossil which Professor M'Coy describes under the name of *Palæopora subtilis*,⁴ and which (from the description given by that author) we are inclined to consider as not differing specifically from *H. inordinata*, appears to be common in the fine Caradoc sandstone of Mulock, Dalquorhan, Ayrshire. Specimens are in the Collection of the Geological Society.

The above-described species differs from the other *Heliolites* by its dendroidal form, and by the development of its septa.

2. Genus PLASMOPORA, (p. lix.)

1. PLASMOPORA PETALIFORMIS. Tab. LIX, figs. 1, 1a, 1b, 1c.

PORITES PETALIFORMIS, Lonsdale, in Murchison, Silur. Syst., p. 687, pl. xvi, fig. 4, 1839.

ASTREOPORA PETALIFORMIS, D'Orbigny, Prodr. de Paléont., vol. i, p. 50, 1850.

PALÆOPORA PETALIFORMIS, M'Coy, Brit. Palæoz. Foss., p. 17, 1851.

PLASMOPORA PETALIFORMIS, Milne Edwards and Jules Haime (*Introd.*, p. lix, 1850), Polyp. Foss. des Terr. Palæoz., p. 221, 1851.

¹ See tab. lvii, fig. 6.

² See tab. lvii, fig. 7.

³ Silurian System, tab. xv, fig. 26.

Corallum massive, hemispherical, free; its edge thin, and its under surface slightly concave, and covered with a strong epitheca wrinkled concentrically. *Calices* circular, almost equal in size, not closely set, and terminated by a very thin, not exsert, margin. *Costæ* very slender, and meeting directly those of the adjoining corallites under an angle, or else bifurcating and joining small transverse laminæ, so as to constitute small polygonal divisions between the calices. These costæ are not closely set; they do not always correspond to the septa, and they often bear some small tubercles laterally. The calicular fossulæ are not very deep, and contain 12 very slender *septa*, which extend almost to the centre, and are somewhat irregular in size. Diameter of the calices almost one line; distance between them somewhat more.

A vertical section shows that the *walls* are slender, but still very distinct, and apparently not perforated. The visceral chambers of the corallites are occupied by large *tabulæ* that are rather closely set, and in general almost horizontal, but somewhat irregular. The space between the corallites is filled up with vertical canaliculæ formed by the costæ that are well developed, and are subdivided by horizontal or slightly convex dissepiments into cells of about one fifth of a line broad.

Upper Silurian deposits at Dudley, Walsall, and Delves Green. Professor M'Coy mentions its existence in the Coniston limestone of Sunny Brow near Coniston, Lancashire; in the impure limestone of Golugood, Mendinam, Caermarthenshire; and at Egool and Bellagherreen, Mayo.

Specimens are in the Collections of Mr. Fletcher and Mr. J. Gray, of Dudley; of the Geological Society, the Parisian Museum, &c.

P. petaliformis much resembles *P. foliis*,¹ but in this last-mentioned species the calices are smaller and more closely set, and the general form of the corallum appears to be constantly different. *P. scita*² is much smaller than *P. petaliformis*, and its septo-costal radii are much more regular.

2. PLASMOPORA SCITA. Tab. LIX, figs. 2, 2a.

PLASMOPORA SCITA, *Milne Edwards and Jules Haime*, Polyp. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 222, 1851.

Corallum free; basal surface slightly convex, with a lamellated and somewhat prominent edge, and covered with a strong, wrinkled epitheca. *Calices* equally developed, shallow, quite circular, with a thin, slightly prominent edge, and set at a distance from each other that does not exceed their diameter. *Costæ* slender, smooth laterally, set wide apart, in direct continuation with the septa, and always joining directly the corresponding ones of the neighbouring corallites, but often united together at their outer edge by a small transverse lamina, which closes up exteriorly the intercostal loculi. *Septa* 12, almost

¹ Milne Edwards and J. Haime, Polyp. Foss. des Terr. Palæoz., p. 223, pl. xvi, fig. 3.

² See tab. lix, fig. 2.

equal in size, rather thick towards the walls, but very slender towards the centre of the corallites. Diameter of the calices about one third of a line.

Upper Silurian beds of Dudley. Collection of Mr. J. Gray.

This species differs from *P. petaliformis*¹ by the calices being much smaller, and more closely set, and by the septo-costal radii being more regular.

3. Genus PROPORA, (p. lix.)

PROPORA TUBULATA. Tab. LIX, figs. 3, 3a, 3b.

PORITES TUBULATA, *Lonsdale*, in Murchison, Silur. Syst., p. 687, pl. xvi, fig. 3, 1839.

ASTREOPORA TUBULATA, LONSDALEI, and GRANDIS, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 50, 1850.

PALÆOPORA TUBULATA, *M'Coy*, Brit. Palæoz. Foss., p. 18, 1851.

PROPORA TUBULATA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Archives du Mus., vol. v), p. 224, 1851.

HELIOLITES ELEGANS and SPINIPORA? *J. Hall*, Paleont. of New York, vol. ii, pp. 130, 131, pl. xxxvi, figs. 1, 2, 1852.

Coralium massive, irregularly convex; common basal plate covered with a epitheca presenting concentric folds; upper surface convex or subgibbose. *Calices* circular, somewhat unequal in size, and surrounded with a slightly prominent edge that is crenulated in consequence of the prolongation of the septa beyond the walls, where they constitute small, thick *costæ*, which are sometimes sufficiently developed to attain those of the adjoining corallites. In general, 12 septa, slightly exsert, rather thick exteriorly, and somewhat unequal in size. Diameter of the calices usually about half a line.

A vertical polished section shows that the *walls* are distinct; the *tabulæ* closely set, concave in the middle, sometimes quite horizontal, and at others irregularly placed; the space situated between the walls of the adjoining corallites occupied by an abundant, irregular exothecal tissue. Some of the dissepiments composing this tissue are horizontal, and assume the appearance of small extramural *tabulæ*, but others constitute vesicular cells. No traces of the *costæ* are seen in this exothecal mass.

The specimens here described were from Dudley and Wenlock. The localities mentioned by Sir R. Murchison are Woolhope Valley, Benthall Edge, Ledbury, Woodside near Nashur, Fownhope, and the west parts of the Malvern Hills, between Asten Ingham and May Hill; by Professor M'Coy, Aymestry, in Herefordshire; Altgoch, Llanfyllin, in Montgomeryshire; Golugoed; Mulock, Dalquorhan, in Ayrshire. The same species is found in Gothland and in Bohemia.

Specimens are in the Collections of the Museum of Practical Geology, of the Geological Society, of the Museum of Paris, &c.

¹ See tab. lix, fig. 1.

This species differs from *P. conferta*¹ by its calices being much smaller and more closely set.

Mr. J. Hall has lately described, under the name of *Heliolites*,² some fossils that appear to be referable to the above-described species. They were found in the limestone of Niagara and Lockport.

Family FAVOSITIDÆ, (p. lx.)

1. Genus FAVOSITES, (p. lx.)

1. FAVOSITES GOTHLANDICA. Tab. LX, figs. 1, 1a.

- TUBER SIVE GLOBUS CORALLINUS? *D. S. Buttners*, Corall. Subterr., p. 17, tab. i, figs. 1, 3, 1714.
- LAPIS CALCARIUS, *Magnus Bromel*, Acta liter. Suec., vol. ii, pp. 414-15, 1728.
- CORALLIUM GOTHLANDICUM, &c., *Fougt*, Amæn. Acad., vol. i, p. 106, tab. iv, fig. 27, 1749.
- FUNGITES? *Thomas Pennant*, Philos. Trans., vol. lix, p. 513, tab. xv, fig. 1, 1757.
- TUBIPORA PRISMATICA, *Lamarck*, Syst. des Anim. sans Vert., p. 377, 1801 (absq. descript.)
- MADREPORA FASCICULARIS? *Parkinson*, Org. Rem., vol. ii, pl. vi, fig. 11, 1808.
- FAVOSITES GOTHLANDICA, *Lamarck*, Hist. des Anim. sans Vert., vol. ii, p. 206, 1816.—2d edit., p. 320.
- — *Defrance*, Dict. Sc. Nat., vol. xvi, p. 298, 1820.
- — *Lamouroux*, Exp. Meth. des G. de Pol., p. 66, 1821.
- — *Lamouroux*, Encycl. (Zooph.), p. 388, 1824.
- CALAMOPORA GOTHLANDICA (pars), *Goldfuss*, Petref. Germ., vol. i, p. 78, pl. xxvi, figs. 3a, 3e, 1829.
- FAVOSITES GOTHLANDICUS, *Eichwald*, Zool. Spec., vol. i, p. 194, 1829.
- RETICULUM? *Ibid.*, p. 194, tab. xi, fig. 14.
- CALAMOPORA GOTHLANDICA (pars), *Morren*, Descr. Cor. in Belg. rept., p. 72, 1832.
- — *Stephen Kutorga*, Beitr. zur Geogr. und Paleont., Dorpat's, p. 24, tab. v, fig. 2, 1835.
- BASALTICA, *Hisinger*, Leth. Suec., p. 96, pl. xxvii, fig. 5, 1837. (Not *Goldfuss*.)
- GOTHLANDICA, *Eichwald*, Sil. Schist. Syst. in Esthland, p. 198, 1840.
- FAVOSITES SUBBASALTICA, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 49, 1850.
- GOTHLANDICA, *M'Coy*, Brit. Palæoz. Foss., p. 20, 1851.
- — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 232, 1851.
- NIAGARENSIS, *J. Hall*, Paleont. of New York, vol. ii, p. 125, pl. xxxiv A (*bis*), fig. 4, and p. 324, pl. lxxiii, fig. 1, 1852.

Corallum massive, convex, sometimes rather tall. *Calices* somewhat unequal in size. 10 or 12 septa. Mural pores surrounded by a small rim, and forming on each

¹ Milne Edwards and J. Haime, Pol. Foss. des Terr. Palæoz., p. 225.

² Paleontology of New York, vol. ii.

portion of the wall two longitudinal series, which alternate. Breadth of the calices somewhat more than 1 line.

Found in the Caradoc sandstone at Cuttimore's Quarry near Tortworth; and in the upper Silurian deposits at Wenlock, and Dinas Court near Aymestry. Professor M'Coy mentions its existence at Dudley; Golugoed, Mendinam, in Caermarthenshire; Ledbury, in Herefordshire; Old Radnor, Presteigne, in Radnorshire. It has also been met with in Groningen, Gothland, Russia, and North America. Mr. Hall has recently mentioned its existence in the Niagara limestone, at Niagara Falls, Lockport, Rochester and Milwaukee, Wisconsin, and in the coralline limestone at Schoharie.

This fossil has, till of late, been confounded with *Favosites Goldfussi*,¹ in which the mural pores are more closely set, and are sometimes opposite, but at other times alternate, in the adjoining series.

2. FAVOSITES ASPERA. Tab. LX, figs. 3, 3a.

CALAMOPORA ALVEOLARIS (pars), *Goldfuss*, Petref., vol. i, p. 77, tab. xxvi, fig. 1b (cæt. excl.), 1829.

— — — *Morren*, Descr. Corall. in Belg. Repert., p. 72, 1832.

FAVOSITES ALVEOLARIS, *Lonsdale*, in Murchison, Silur. Syst., p. 681, pl. xv bis, fig. 2, and perhaps also the fig. 1, 1839.

CALAMOPORA ALVEOLARIS, *Ed. Eichwald*, Sil. Schist. Syst. in Esthland, p. 198, 1840.

FAVOSITES ALVEOLARIS, *Lonsdale*, in Murch., Vern. and Keys. Russia and Ural, vol. i, p. 610, 1845.

CALAMOPORA ALVEOLARIS, *Keyserling*, Reise in Petschora, p. 177, 1846.

FAVOSITES ASPERA, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 49, 1850.

— — ? *M'Coy*, Brit. Palæoz. Foss., p. 20, 1851.

— — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 234, 1851.

Corallum massive, with an almost flat surface; calices unequal in size. Tabulæ presenting six large, and well-marked submarginal fossulæ. Mural pores rather closely set, and placed at the angles of the visceral chamber. Diagonal of the large calices somewhat more than 1 line.

Found in the Caradoc sandstone at Powis Castle, Cefn-y-garrey, Llandovery; in Wenlock limestone, at Leinthall Earls near Ludlow. According to Mr. Lonsdale, in the middle and lower Ludlow rocks, at Mocktree Hill, Aymestry, and Tatton Edge; and in the Wenlock limestone, at Purlieux, Malvern, Haven near Aymestry, Hurst Hill near Sedgley, the western side of the Malvern Hills, Abberley, Little Ridge, Easthop, Winslow Mill, Townhope, Westhope, and Woolhope. Professor M'Coy has found it at Ardaun, and Cappacorcogne, Cong, in the county of Galway; Foylathurrig, Dingle, in the county

¹ See tab. xlvii, fig. 3

of Kerry; Portrane and Malahide, in the county of Dublin. It exists also in Sweden, Holland, and Russia.

Specimens are in the Collections of the Geological Society, of the Poppelsdorff Museum at Bonn, of M. de Verneuil, Paris, &c.

This species much resembles *Favosites alveolaris*,¹ with which it is often confounded, but differs from it by the size and number of the marginal fossulæ of the tabulæ, as well as by the calices being more unequal in size.

3. FAVOSITES MULTIPORA. Tab. LX, fig. 4.

FAVOSITES MULTIPORA, *Lonsdale*, in Murchison, Silur. Syst., p. 683, pl. xv *bis*, fig. 5, 1839.

— — *M'Coy*, Synopsis of the Silurian Fossils of Ireland, p. 63, 1846.

— — *D'Orbigny*, Prodr. de Paléont., vol. i, p. 48, 1850.

— ALVEOLARIS? *M'Coy*, Brit. Palæoz. Foss., p. 19, 1851.

— MULTIPORA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 237, 1851.

Corallum hemispherical; common basal plate covered with a concentrically wrinkled epitheca. *Calices* of equal size, and arranged in very regular series, that form somewhat elongated hexagones, the opposite angles of which are of equal value. Each portion or side of the walls generally present three series of pores, closely set, and arranged somewhat irregularly. Large diagonal of the calices about half a line.

Found in the Caradoc sandstone at Haverfordwest, and in the Wenlock limestone at Marloes Bay, in Pembrokeshire. Professor M'Coy has met with it also in Galway and Kerry.

Specimens are in the Collections of the Geological Society of London, and of the Museum of Practical Geology.

This fossil differs from the other species of *Favosites* by the regularity of its calices, and the abundance of its mural pores.

4. FAVOSITES FORBESI. Tab. LX, figs. 2, 2a, 2b, 2c, 2d, 2e, 2f, 2g.

MADREPORA SUBROTUNDA? &c., *Fougé*, Amæn. Acad., vol. i, p. 100, tab. iv, fig. 17, 1749.

CALAMOPORA BASALTICA (pars), *Goldfuss*, Petref. Germ., vol. i, p. 78, tab. xxvi, fig. 4b, 1829.

— — *Morren*, Descr. Cor. Belg., p. 73, 1832.

— GOTHLANDICA, *Hisinger*, Leth. Suec., p. 96, tab. xxvii, fig. 4, 1378. (Not *Goldfuss*.)

FAVOSITES GOTHLANDICA, *Lonsdale*, in Murchison, Sil. Syst., p. 682, pl. xv *bis*, fig. 3, 4, 1839. (Not of *Lamarck*.)

— — *D'Orbigny*, Prodr. de Paléont., vol. i, p. 48, 1850.

— FORBESI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 238, 1851.

¹ *Goldfuss*, Petref. Germ., vol. i, pl. xxvi, fig. 1a, 1c.

Corallum massive, convex or subgibbose. *Calices* unequal in size; the large ones usually dispersed amongst the smaller ones, almost circular, and about 1 line in diameter, the smallest about a quarter of a line in diameter; others presenting all the intermediate degrees between these two sizes. In some specimens the difference between the calices is much less marked. A vertical section shows that the walls are thin, and the tabulæ horizontal, and, in general, closely set, but very unequally so.

Found in the lower Silurian deposits at Under Daniell's Wood, Tortworth; in the Wenlock limestone at Wren's Nest, Dudley, Benthall Edge, Falfield near Tortworth, Much Wenlock; and, according to Mr. Lonsdale, in the lower Ludlow rocks at Sitch Wood, Ledbury, Wentwoon Common, Wenlock; and in the middle Ludlow rocks, at Aymestry, Tatton Edge, Downton on the Rock. Professor M'Coy mentions its existence at Ardaun, Cong, and Kilbridge, in Galway; and at Egool and Bellaghaderreen, in the county of Mayo. It is also met with in Sweden.

Specimens in the Collections of the Geological Society, of the Museum of Practical Geology, of Mr. J. S. Bowerbank, of the Bristol Museum, &c.

Some very small specimens, found at Dudley, and belonging to the Collections of Mr. Fletcher and of Mr. Bowerbank, present the general characters of this species, but have much larger calices; they appear to be young colonies of the above-described species, and we easily understand how the mode of multiplication of *Favosites* must tend to diminish the dimensions of the large corallites, as the number of individuals so produced augments.

In no other species of this genus is the difference in the size of the calices so great as in *F. Forbesi*.

5. *FAVOSITES HISINGERI*. Tab. LXI, figs. 1, 1a, 1b.

TUBULARIA FOSSILIS, &c., *Magnus Bromel*, Acta Liter. Suec., vol. ii, p. 408, 1728.

MADREPORA PORIS, &c., *Fougé*, Amæn. Acad., vol. i, p. 101, tab. iv, fig. 21, 1749.

FUNGITES, *Th. Pennant*, Philos. Trans., vol. xlix, 2d part, p. 513, tab. xv, fig. 4, 1753.

FAVOSITES ALCYON? *DeFrance*, Dict. Sc. Nat., vol. xvi, p. 298, 1820.

— GOTHLANDICA? *De Blainville*, Dict. Sc. Nat. (Atlas Zooph.), pl. xl, fig. 4, 1830.

—Man. d'Actin., pl. lxii, fig. 4.

— ALCYON? *De Blainville*, Dict., pl. xlii, fig. 5.—Man., pl. lxiv, fig. 5.

FAVOSITES? *Pander*, Beitr. zur Geogn. des Russ. Reiches, pl. xxix, fig. 9, 1830.

CALAMOPORA MINUTISSIMA? *Castelnau*, Terr. Sil. de l'Amér. du Nord, pl. xviii, fig. 2, 1843.

FAVOSITES HISINGERI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 240, pl. xvii, figs. 2, 2a, 2b, 1851.

ASTROCERIUM VENUSTUM, *J. Hall*, Paleont. of New York, vol. ii, p. 120, pl. xxxiv, fig. 1, 1852.

Corallum massive, subgibbose. Calices almost equal in size, separated by walls that are rather thick, in general pretty regularly hexagonal, and about half a line in diameter.

12 septa, subequal, not very thick, extending to the centre of the corallites, and formed by well-developed, slightly curved processes. Tabulæ slender, rather closely set, and horizontal, or somewhat flexuous.

Lower Silurian deposits at Cullimore's Quarry, Tortworth; upper Silurian rocks of Benthall Edge, Wenlock Edge; Gothland; and Niagara limestone, at Lockport, and Rochester (J. Hall).

Specimens in the Collections of the Museum of Practical Geology, of the Geological Society, of the Bristol Museum, of Mr. Bowerbank, of the Museum of Paris, &c.

In this species the septal processes are bent upwards, and more developed than in the other Favosites. Mr. Hall has, for that reason, proposed placing it in a new generical division, under the name of *Astrocerium*:¹ but every intermediate degree between this structure and the most rudimentary state of the septal system in some other Favosites are met with, so that the line of separation would be arbitrary, and it is also to be remembered that in many cases the delicate and brittle processes which constitute the septa, have evidently disappeared during the fossilisation of the coral. In *Favosites Goldfussi*,² for example, we have found distinct remains of the septal processes only in two specimens, although we have searched attentively for them in several hundred specimens found in various localities.

We are inclined to think that the Dudley fossil, mentioned by Parkinson under the name of *Porpital madreporite*,³ and by Dr. Fleming under that of *Sarcinula angularis*,⁴ is referable to the above-described species.

6. FAVOSITES CRISTATA. Tab. LXI, figs. 3, 3a, and 4, 4a?

MADREPORITES CRISTATUS, *Blumenbach*, Comment. Soc. Scient. Gött., vol. xv, p. 154, tab. iii, fig. 12, 1803.

CALAMOPORA POLYMORPHA, *Hisinger*, Leth. Suec., p. 97, tab. xxvii, fig. 6, 1837. (Not of *Goldfuss*.)

— SPONGITES? *Ibid.*, p. 97, tab. xxvii, fig. 7. (Not of *Goldfuss*.)

FAVOSITES POLYMORPHA, *Lonsdale*, in Murchison, Silur. Syst., p. 684, pl. xv, fig. 2, 1839.

CALAMOPORA POLYMORPHA, *Eichwald*, Silur. Schist. Syst. in Esthland, p. 198, 1840.

FAVOSITES POLYMORPHA, *Lonsdale*, M. V. K. Russ. and Ural, vol. i, p. 610, 1845.

ALVEOLITES LONSDALEI, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 49, 1850.

FAVOSITES CRISTATA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Perr. Palæoz. (Arch. du Mus., vol. v), p. 242, 1851.

Corallum dendroidal; its branches generally spreading, cylindrical, and submamilllose. *Calices* somewhat unequal in size, often almost circular, and with a rather thick margin. The large ones about half a line in diameter.

¹ Paleontology of New York, vol. ii, p. 120, 1852.

² See tab. xlvii, fig. 3.

³ Org. Remains, vol. ii, p. 69, tab. vii, figs. 3, 7.

⁴ British Animals, p. 508, 1828.—Woodward, Syn. Tab. of Brit. Org. Rem., p. 5, 1830.

Upper Silurian beds of Wenlock, Ludlow, Dudley, Ireland, Sweden, and Russia.

Specimens in the Collections of the Museum of Practical Geology, of the Geological Society, of Mr. Bowerbank, of the Museum of Paris, &c.

This coral bears great resemblance to *Favosites cervicornis*,¹ and we are even doubtful as to its being specifically different from it; its calices are, however, less unequal in size, and almost circular.

In a Dudley specimen, which we consider as belonging to the above-described species, the large calices were not more than two fifths of a line in diameter.

According to Mr. Lonsdale, the same species appears to exist in the Devonian formation of the Oural Mountains.

7. *FAVOSITES FIBROSA*. (See p. 217, and Tab. XLVIII, fig. 3.) Tab. LXI, figs. 5, 5a.

STENOPORA FIBROSA, M'Coy, Brit. Palæoz. Foss., p. 24, 1851.

ASTROCERIUM CONSTRICTUM, J. Hall, Paleont. of N. Y., vol. ii, p. 123, pl. xxxiv A, figs. 2 and 3, 1852.

Lower Silurian, Horderley, and Llandovery.

According to Professor M'Coy (op. cit.), this species has been found in the Coniston limestone schists of Llansantfraid, the Caradoc sandstone schists of Bala, the Upper Ludlow rocks, the Wenlock limestone, the limestone of Llandeilo, &c., of a great quantity of British localities.

Professor Hall indicates it in the shale of the Niagara group at Lockport.

8. *FAVOSITES CRASSA*.

FAVOSITES CRASSA, M'Coy, Ann. and Mag. of Nat. Hist., 2d series, vol. vi, p. 284, 1850.

— — M'Coy, Brit. Palæoz. Foss., p. 20, pl. i c, fig. 9, 1851.

"*Corallum* forming large, subcylindrical, curved branches, composed of long, slightly diverging, remarkably regular and equal prismatic tubes, opening as thin-walled polygonal cells on the surface, with a nearly uniform diameter of half a line; two rows of pores on each face of the prismatic tubes, diaphragms either slightly more or less than the diameter of the tubes apart; interpolated young tubes few.

"In the Coniston limestone, Coniston Water-head, Lancashire."

FAVOSITES? *OCULATA*, M'Coy, Brit. Palæoz. Foss., p. 21—*Ceriopora oculata*, Goldfuss, Petref. Germ., vol. i, tab. lxiv, fig. 14,—appears to appertain to the class of Bryozoa.

¹ See tab. xlviii, fig. 2.

2. Genus ALVEOLITES (p. lx).

1. ALVEOLITES LABECHEI. Tab. LXI, figs. 6, 6a, 6b.

FAVOSITES SPONGITES (pars), *Lonsdale*, in Murchison, *Silur. Syst.*, pl. xv *bis*, figs. 8, 8a, 8b (cæt. excl.), 1839. (Not *Calamopora spongites*, Goldfuss.)

CALAMOPORA SPONGITES, *Eichwald*, *Sil. Syst. in Esthland*, p. 197, 1840.

ALVEOLITES LABECHII, *Milne Edwards* and *Jules Haime*, *Pol. Foss. des Terr. Palæoz.* (*Arch. du Mus.*, vol. v), p. 257, 1851.

Corallum massive, convex or subgibbose, very closely resembling the *Alveolites suborbicularis*¹ of the Devonian formation; but differing from it, by the calices being more irregular, scarcely prominent, with very thin edges, and subtriangular, and by the inner process being very indistinct. Large diameter somewhat more than one third of a line; small diameter one third less.

Found in the upper Silurian deposits at Wenlock, and at Benthall Edge. Professor M'Coy² mentions its existence at Doonquin, Dingle, and Ferriter's Cove, in the county of Kerry; Egool and Bellagherreen, in the county of Mayo; River Chapel and Gorey, in the county of Wexford. According to *Eichwald*, it exists also in Russia.

Specimens are in the Collections of the Museum of Practical Geology of London, of the Parisian Museum, of M. Bouchard-Chantreaux at Boulogne.

2. ALVEOLITES GRAYI. Tab. LXI, figs. 2, 2a.

ALVEOLITES GRAYI, *Milne Edwards* and *Jules Haime*, *Pol. Foss. des Terr. Palæoz.* (*Arch. du Mus.*, vol. v), p. 258, 1851.

Corallum presenting a flat or submamilllose surface. *Calices* very irregular, inclined in various directions, in general subtriangular, and having their outer margin somewhat arched. The elevation situated on the inner surface of this inferior calicinal edge in general distinct, but not very prominent. Walls rather thick. Size of the calices: large diameter about half a line, small diameter one third less.

Upper Silurian rocks of Wenlock and Dudley. Specimens in the Collections of the Museum of Practical Geology, of Mr. J. Gray of Dudley, and of the Museum of Paris.

This species much resembles *Alveolites suborbicularis*³ and *A. Labechei*,⁴ but its calices are always larger, and limited by walls that are thicker in proportion to the size of the corallites.

¹ See tab. xlix, fig. 1.

² Synopsis of the Silurian Fossils of Ireland, p. 64.

³ See tab. xlix, fig. 1.

⁴ See tab. lxi, fig. 6.

3. ALVEOLITES REPENS. Tab. LXII, figs. 1, 1a.

- MILLEPORA REPENS, *Fougt*, Amæn. Acad., vol. i, p. 99, tab. iv, fig. 25, 1749.
 — RAMIS, &c., *Ibid.*, p. 98, tab. iv, fig. 14.
 — CERVICORNIS? *Wahlenberg*, Nov. Acta Soc. Upsal., vol. viii, p. 100, 1820.
 CALAMOPORA FIBROSA, var. RAMIS GRACILIBUS, *Goldfuss*, Petref. Germ., vol. i, p. 82, tab. xxviii, fig. 4, 1826.
 POCILLOPORA APPROXIMATA? *Eichwald*, Zool. Spec., vol. i, p. 182, 1829.
 MILLEPORA BURTINIANA? *Morren*, Descr. Cor. Belg., p. 25, tab. vii, figs. 1—4, 1832.
 — REPENS, *Hisinger*, Leth. Suec., p. 102, tab. xxix, fig. 5, 1837.
 — RAMOSA, *Ibid.*, p. 103, tab. xxix, fig. 6. (It is a worn specimen.)
 — REPENS? *Lonsdale*, in Murchison, Silur. Syst., p. 680, pl. xv, fig. 30 (excl., fig. 30a), 1830.
 CHÆTETES REPENS, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 49, 1850.
 ALVEOLITES REPENS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 258, 1851.
 CLADOPORA SERIATA, *J. Hall*, Paleont. of New York, vol. ii, p. 137, pl. xxxviii, fig. 1, 1852.

Corallum ramose; its branches slender (in general not more than two lines in diameter) and frequently coalescent. *Calices* rather closely set, somewhat broader than high; their exterior margin presenting a medial fissure, on each side of which is a small denticulation of unequal size. Breadth of the calice about one fifth of a line.

From the upper Silurian rocks of Dudley and Wenlock. Sir R. Murchison has also found it at Lincoln Hill, Coalbrook Dale, Benthall Edge, Hurst Hill, and Sedgley. It is also met with in Gothland; and in North America, where Mr. Hall has recently found it at Lockport.

Specimens in the Collections of Mr. Fletcher, of the Paris Museum, &c.

*Alveolites vermicularis*¹ much resembles this species, but its branches are much thicker, and the angle formed by the bifurcation of its branches is much more open; the outer margin of the calices is also more prominent than in *A. repens*.

4. ALVEOLITES? SERIATOPOROÏDES. Tab. LXII, figs. 2, 2a.

- MILLEPORA RAMIS, &c., *Fougt*, Amæn. Acad., vol. i, p. 98, tab. iv, fig. 15, 1849.
 MILLEPORITES REPENS, *Wahlenberg*, Nov. Acta Soc. Upsal., vol. viii, p. 100, 1821. (Not of Fougt.)
 MILLEPORA REPENS (pars), *Lonsdale*, in Murchison, Silur. Syst., pl. xv, fig. 30a, 1839.
 ALVEOLITES? SERIATOPORA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 260, 1851.
 CLADOPORA MULTIPORA, *J. Hall*, Paleont. of New York, vol. ii, p. 140, pl. xxxix, figs. 1a, 1b, 1c, 1d (cæt. excl.?), 1852.

¹ See tab. xlviii, fig. 5.

This small ramose coral appears to be intermediate between true Alveolites and Cœnites ; it resembles the latter by the great development of its cœenchyma, and Alveolites by the almost circular form of the calices, but differs from both by the direction and the mode of arrangement of the corallites, which, instead of being oblique, are almost perpendicular to the axis of the branches, and form vertical series somewhat as in the genus Seriatopora. When this fossil becomes more completely known in its structural characters, it will probably form the type of a new generical division. Mr. Hall places it in his genus Cladopora, which is partly composed of Bryozoa.

Diameter of the branches about one and a quarter line ; diameter of the calices about one fifth of a line.

Dudley. Mr. Hall mentions its existence in the lower part of the Niagara limestone at Lockport.

Collections of Mr. Fletcher and of the Parisian Museum.

3. Genus MONTICULIPORA.¹

1. MONTICULIPORA PETROPOLITANA.

FAVOSITES PETROPOLITANUS, *Pander*, Russ. Reiche, p. 105, tab. i, figs. 6, 7, 10, 11 (excl., fig. 8), 1830.

CALAMOPORA FIBROSA (pars), *Goldfuss*, Petref. Germ., vol. i, p. 215, tab. lxiv, fig. 9, 1833.

FAVOSITES HEMISPHERICUS, *St. Kutorga*, Zweit. Beitr. zur Geogn. und Paleont. Dorp., p. 40, tab. viii, fig. 5, and tab. ix, fig. 3, 1837.

CALAMOPORA FIBROSA, *Eichwald*, Sil. Syst. in Esthl., p. 197, 1840.

FAVOSITES LYCOPODITES, *Lardner Vanuxem*, Geol. of New York, 3d part, p. 46, fig. 3, 1842.

— — *Will. Mather*, Geol. of New York, 1st part, p. 397, fig. 3, 1843.

CHÆTETES PETROPOLITANUS, *Lonsdale*, in Murch., Vern. and Keys., Russ. and Ural, vol. i, p. 596, tab. A, fig. 10, 1845.

— — *Keyserling*, Reise in Petsch., p. 180, 1846.

FAVOSITES PETROPOLITANA, *M'Coy*, Syn. of the Silur. Foss. of Irel., p. 64, pl. iv, fig. 21, 1846.

¹ D'Orbigny, Prodr. de Paléont., vol. i, p. 25, 1850 ; *Nebulipora*, M'Coy, Ann. and Mag. of Nat. Hist., 2d series, vol. vi, p. 283, 1850 ; and Brit. Palæoz. Fossils, p. 22, 1851.

This generical division was proposed by M. D'Orbigny, since the publication of the Classification of Polypi, given in the introduction to this work, and the great resemblance which exists between the corals included in this new group and the common *Chætetes* induced us to reject it ; in our *Monographie des Polypiers Fossiles des Terrains Palæozoïques*, we therefore included all these fossils in the old genus *Chætetes* of Fischer. But since that we have observed some specimens in which the fissiparous mode of reproduction, attributed by Fischer to his original *Chætetes*, is quite distinct ; whereas, in the species to which M. D'Orbigny gives the name of *Monticulipora*, the gemmiparous reproduction is evident. We therefore now think it advisable to admit the generical distinction established by that palæontologist. Besides the

- CHÆTETES LYCOPERDON (pars), *Hall*, Paleont. of New York, vol. i, p. 64, pl. xxiii, fig. 1, and pl. xxiv, figs. 1 a—h, and perhaps also pl. lxxv, fig. 2 (cæt. excl.), 1847.
- CHÆTETES RUGOSUS, *Ibid.*, vol. i, p. 67, pl. xxiv, fig. 2.
- PETROPOLITANUS, LYCOPERDON, and SUBFIBROSUS, *D'Orbigny*, Prodr. de Paléont., vol. i, pp. 25 and 108, 1850.
- — — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 263, 1851.
- LYCOPERDON (pars), *Hall*, Paleont. of New York, vol. ii, p. 40, pl. xvii, fig. 1 a—f, 1852. (Cæt. excl.)

Corallum in general free; its basal plate flat or concave, and completely covered with a concentrically wrinkled epitheca. Upper surface regularly convex, in general hemispherical, and presenting obtuse tuberosities, about one line broad, and varying very much in height. In some specimens these tubercles appear to have been worn away, and their existence is indicated only by the presence of small groups of large calices, with thick walls; the calices are rather unequal in size, generally polygonal, sometimes almost circular; the largest are about one fifth of a line in diameter; the walls are not perforated; the tabulæ are horizontal, complete, and placed at about one twelfth of a line from each other. Some vestiges of septa are often visible. Young specimens are flat and discoidal.

This species is found in the lower Silurian deposits at Caradoc and Ony River. Profr. M'Coy mentions its existence at Glounmore and Ventry Harbour, in the county of Kerry; at Knockmahon, Tramore, and Ballydowan Bay, Waterford county. It is also met with

species here mentioned, the genus *Monticulipora* comprehends the following fossils, which, in our work on the Palæozoic Corals, were placed in the genus *Chætetes*.

- C. Panderi*, *Milne Edwards* and *Jules Haime*, op. cit., p. 265.
- Monticulipora filiasa*, *D'Orbigny*, Prod. de Paléont., tab. i, p. 25.—*Chætetes filiasa*, *Milne Edwards* and *J. Haime*, op. cit., p. 266.
- C. Dalei*, *M. Edwards* and *J. Haime*, op. cit., p. 266, pl. xix, fig. 6.
- Monticulipora ramosa*, *D'Orbigny*, op. cit., p. 25.—*Chætetes ramosus*, *M. Edwards* and *J. Haime*, op. cit., p. 266 pl. xix, fig. 2.
- *mammulata*, *D'Orbigny*, loc. cit.—*Chætetes mammulatus*, *M. Edwards* and *J. Haime*, op. cit., p. 267, pl. xix, fig. 1.
- *frondosa*, *D'Orbigny*, loc. cit.—*Chætetes frondosus*, *M. Edwards* and *J. Haime*, loc. cit., pl. xix, fig. 5.
- Ptilodictya pavonia*, *D'Orbigny*, op. cit., p. 22.—*Chætetes pavonia*, *M. Edwards* and *J. Haime*, loc. cit., pl. xix, fig. 4.
- Chætetes rugosus*, *M. Edwards* and *J. Haime*, op. cit., p. 268, pl. xx, fig. 6.
- *Torrubiai*, *De Verneuil* and *J. Haime*, Bullet. Soc. Géol. de France, s. 2, v. vii, p. 162.—*M. Edwards* and *J. Haime*, loc. cit., pl. xx, fig. 5.
- *Trigeri*, *M. Edwards* and *J. Haime*, op. cit., p. 269, pl. xvii, fig. 6.
- *heterosolen*, *Keyserling*, Reise in Petsch., p. 181, fig. a, b.

in North America, and in Russia. In his recent work, Mr. Hall mentions its existence in the lower parts of the Clinton group in Wayne county, in Niagara county, and at Flamborough Head, in Canada West.

Specimens are in the Collections of the Geological Society of London, of the Museum of Paris, of M. de Verneuil, M. D'Orbigny, &c.

*M. Panderi*¹ very much resembles this species, but differs from it by its turbinate form, and the rudimentary state of the tubercles on its upper surface.

2. MONTICULIPORA PAPILLATA. Tab. LXII, figs. 4, 4a.

NEBULIPORA PAPILLATA, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. vi, p. 284, 1850.

— — — *M'Coy*, Brit. Palæoz. Foss., p. 24, pl. i c, fig. 5, 1851.

CHÆTETES TUBERCULATUS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 268, pl. xix, figs. 3, 3a, 1851.

RHINOPORA TUBERCULOSA? *J. Hall*, Paleont. of New York, vol. ii, p. 170, pl. 40 E, fig. 4, 1852.

Corallum very thin, incrustating. Tubercles much compressed, elongated in the same longitudinal direction, rather prominent, about one line in length, one half more in breadth, and set at a distance from each other equal to about twice their breadth; the top of these tubercles is rather compact. Calices somewhat unequal in size and in form; those that are placed on the tubercles being rather larger than the others, and about one third of a line in breadth.

Found in the upper Silurian rocks of Dudley. Professor M'Coy has met with it in the upper Ludlow rocks of Brigsteer, Kendal, Westmoreland; at Coniston, Lancashire; and at Firbank, Sedbergh, Kendal. It exists also in the blue limestone of Cincinnati, Springfield, and Lebanon, in Ohio.

Specimens are in the Collections of Mr. Fletcher of Dudley, and of M. de Verneuil at Paris.

This species much resembles *M. mammulata*,² in which, however, the tubercles are more prominent, more elongated, and more irregular. *Monticulipora Dalei*³ is also very closely allied to the above-described species, but differs from it by its dendroidal form, and its small round tubercles.

¹ *Chætetes Panderi*, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 265, 1851.

² *Chætetes mammulatus*, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 267, pl. xix, fig. 1.

³ *Chætetes Dalei*, *ibid.*, p. 266, p. xix, fig. 6.

3. MONTICULIPORA FLETCHERI. Tab. LXII, figs. 3, 3a.

CALAMOPORA SPONGITES? var. *Goldfuss*, Petref. Germ., vol. i, p. 216, pl. 64, fig. 10 (in parte), 1833.

FAVOSITES SPONGITES (pars), *Lonsdale*, in Murchison, Silur. Syst., pl. xv bis, figs. 9, 9a, 9b (cæt. excl.), 1839.

CHÆTETES FLETCHERI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 271, 1851.

— LYCOPERDON (pars), *J. Hall*, Paleont. of New York, vol. ii, p. 40, pl. xvii, figs. 1 g—i (cæt. excl.), 1852.

Corallum dendroidal; branches about one and a half or two lines in diameter, and not bearing any well-characterised tubercles. *Calices* of two kinds; some circular, very closely set, and about one eighth of a line in diameter; others subpolygonal, much smaller, and placed between the former ones.

Dudley. North America, in the Clinton group (J. Hall).

Specimens are in the Collections of the Geological Society, of Mr. Fletcher, of the Museum of Paris, &c.

By its general form *M. Fletcheri* resembles *M. pulchella*,¹ but its branches are slenderer, and bifurcate under a more obtuse angle. Both these species are almost deprived of the tubercles which are in general so remarkable in the corals of this genus, but the mode of arrangement of the calices differs: in *M. pulchella*, the large calices are in general collected in groups amongst the smaller ones; whereas, in *M. Fletcheri*, the smaller cells are set irregularly between the large ones, which vary but little.

4. MONTICULIPORA PULCHELLA. Tab. LXII, figs. 5, 5a, 5b.

CHÆTETES PULCHELLUS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 271, 1851.

Corallum ramose; its branches often somewhat compressed, and from two to four lines in diameter. Tubercles broad, not very prominent, and somewhat stellated. *Calices* rather regularly hexagonal, and very unequal in size; those that occupy the centre of the tubercles about one fifth of a line in diameter, and at least twice as large as those placed in the intervals between the groups thus formed.

Wenlock, Dudley, Coalbrook Dale.

Specimens in the Collections of the Geological Society, of Mr. Fletcher, &c.

This species, as we have already mentioned, much resembles *Monticulipora Fletcheri*,² but differs from it by the mode of grouping of the cells, and the size and the angle of bifurcation of its branches.

¹ See tab. lxii, figs. 5, 5a.

² See tab. lxii, fig. 3.

5. MONTICULIPORA? BOWERBANKI. Tab. LXIII, figs. 1, 1a, 1b, 1c.

FAVOSITES SPONGITES (pars), *Lonsdale*, in Murchison, Silur. Syst., p. 683, pl. xv *bis*, figs. 8c, 8d, 8e (cæt. excl.), 1839. (Not the *Calamopora spongites* of Goldfuss.)

DISCOPORA SQUAMATA? *Ibid.*, p. 679, pl. xv, fig. 23.

CHÆTETES? BOWERBANKI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 272, 1851.

The general form of this coral varies much at different ages. In young specimens it is massive, subspherical, and but slightly gibbose; but in older specimens the tuberosities appear to have risen up, so as to constitute cylindrical flexuous branches; and in a very large specimen these branches are ramose, very tall, numerous, and compose a cæspitose mass. The upper end of each of these branches is dilated so as to form a kind of round head, the surface of which does not present any tubercles, and is occupied by closely set subpolygonal slanting calices that are about one fifth or two fifths of a line in diameter, and much resemble those of Alveolites, but are deprived of septal processes.

From Much Wenlock, Benthall Edge, Dudley, Walsall, and, according to Mr. Lonsdale, Hurst Hill, Sedgley.

Specimens are in the Collections of Mr. Bowerbank, Mr. Fletcher, and M. de Verneuil.

The ill-preserved fossil, from Desertcreat, which Mr. Portlock has represented under the name of *Favosites polymorpha*,¹ appears to be referable to this species, which is remarkable for the slight difference of size between its calices, the lozenge form of these, and its general aspect.

6. MONTICULIPORA EXPLANATA.

NEBULIPORA EXPLANATA, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. 6, p. 283, 1850.—Brit. Palæoz. Foss., p. 23, pl. i c, fig. 6, 1851.

“*Corallum* forming very thin, irregularly expanded laminæ, upwards of two inches long, covered above with nearly regular, quincuncially arranged, flat or slightly depressed, nebular clusters of larger tubes, about one and a half lines in diameter, and rather less than twice their diameter apart (about twelve or fourteen cells between one centre and the next); smaller intermediate tubes about six in one line.

“Coniston limestone, Coniston, Lancashire; limestone of Applethwaite Common, Westmoreland.” *M'Coy*, op. cit.

¹ Report on the Geol. of Londonderry, &c., p. 326, pl. xxi, fig. 2a.

7. MONTICULIPORA LENS.

NEBULIPORA LENS, M'Coy, Ann. and Mag. of Nat. Hist., 2d series, vol. 6, p. 283, 1850.

— — M'Coy, Brit. Palæoz. Foss., p. 23, pl. i c, fig. 7, 1851.

"*Corallum* forming lenticular masses, averaging 10 lines in diameter, and $1\frac{1}{2}$ lines thick in the middle, gradually thinning to the edge; base slightly concave, with small concentric wrinkles; upper surface evenly convex; clusters of large cells rounded, flat, or slightly concave, about 1 line in diameter, and usually a little more than their diameter apart (averaging from sixteen to twenty cells between one centre and another); smaller tubes averaging eight in one line, larger tubes of the clusters averaging four or five in one line; two inter-diaphragmal spaces equal the diameter of the tubes; apparently two irregular, close rows of connecting pores on each face of each tube (?).

"Caradoc sandstone of Horderly West; schists of Moel Uchlas? Pont y Glyn, Diffwys, near Corwen; Cwm of the Cymmerig, Bala." M'Coy, op. cit.

STENOPORA? GRANULOSA, M'Coy, Brit. Palæoz. Foss., p. 26; *Ceripora granulosa*, Goldfuss, Petref. Germ., vol. i, tab. lxiv, fig. 13; is a fossil coral from Dudley, which appears to belong to the class of Bryozoa.

4. Genus LABECHEIA.¹

1. LABECHEIA CONFERTA. Tab. LXII, figs. 6, 6a, 6b, 6c.

MONTICULARIA CONFERTA, Lonsdale, in Murchison, Silur. Syst., p. 688, pl. xvi, fig. 5, 1839.

LABECHEIA CONFERTA, Milne Edwards and Jules Haime, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 280, 1851.

Corallum massive, or forming lamellar expansions, which are often incrustating. Common basal plate covered with a thick, wrinkled epitheca; upper surface flat or sub-mammillar, and covered with small granular conical tubercles, which appear to rise from the edge of the walls; calices confluent and not distinct; visceral chambers filled up with complete, horizontal, closely set tabulæ, and presenting quite rudimentary septa. Walls thick, and not perforated. Breadth of the visceral chamber about a quarter of a line.

In some specimens the marginal mural tubercles are ranged in regular series, so as to assume the appearance of small ridges.

¹ See Milne Edwards and Jules Haime, Pol. Foss. des Terr. Palæoz., p. 279, 1851.

From Wenlock, Benthall Edge, Gleedon Hill; Ardaun and Cong, Galway (M'Coy).

Specimens are in the Collections of the Museum of Paris, of the Museum of Practical Geology, of the Bristol Museum, of the Geological Society, of Mr. Fletcher, of Mr. J. Gray, &c.

This fossil was placed by Mr. Lonsdale in the genus *Monticularia* (*Hydnophora*), which it resembles in some of its exterior characters; but it differs most essentially, not only from *Hydnophora*, but also from all the other corals belonging to the large family of the *Astræidæ*, by existence of its well-developed tabulæ, and rudimentary state of the septal apparatus. This mode of structure is characteristic of the group of *Favositidæ*. It has great affinity with *Chætetes*, but differs from that genus by the mode of termination of its walls, and constitutes, in our system of classification, a new generical division, which we have dedicated to our celebrated friend, Sir Henry de la Beche, to whom geology in general, and more especially the geology of England, is most deeply indebted.

5. Genus HALYSITES, (p. lxii.)

1. HALYSITES CATENULARIA. Tab. LXIV, figs. 1, 1a, 1b, 1c.

TUBULARIA FOSSILIS, &c., *Magnus Bromel*, Acta Liter. Suec., vol. ii, pp. 410, 411, and 412, figs. 2 and A, 1728.

MADREPORA TUBIS, &c., *Fougé*, Amæn. Acad., vol. i, p. 103, tab. iv, fig. 20, 1749.

TUBIPORA CATENULARIA, *Linné*, Syst. Nat., ed. 12, p. 1270, 1767.

FUNGITE, *Knorr and Walch*, Rec. des Mon. des Cat., vol. ii, pl. F 9*, fig. 4, 1775.

TUBIPORA FLABELLARIIS? *Othon Fabricius*, Fauna Groenl., p. 432, 1788.

— CATENULATA, *Gmelin*, Syst. Nat., ed. 13, p. 3753, 1789.

— — *Parkinson*, Org. Rem., vol. ii, pl. iii, figs. 5, 6, 1808.

TUBIPORITES CATENARIUS, *Schlotheim*, Petref., 1st part, p. 366, 1820.

CATENIPORA TUBULOSA, *Lamouroux*, Exp. Meth. des G. de Pol., p. 65, 1821.

— — *Lamouroux*, Encycl. (Zooph.), p. 177, 1824.

— LABYRINTHICA, *Goldfuss*, Petref. Germ., vol. i, p. 75, tab. xxv, fig. 5, 1826.

HALYSITES ATTENUATA, *Fischer*, of Waldheim, Not. sur des Tubip. Foss., p. 16, fig. 4, 1828.

— DICHOTOMA, *Ibid.*, p. 17.

— MICROSTOMA, *Ibid.*, p. 18.

— STENOSTOMA, *Ibid.*, p. 18.

CATENIPORA APPROXIMATA, *Eichwald*, Zool. Spec., vol. i, p. 192, tab. ii, fig. 9, 1829.

— DISTANS, *Ibid.*, p. 192, tab. ii, fig. 10.

— COMMUNICANS? *Ibid.*, p. 193.

— or TUBIPORA, *R. C. Taylor*, Mag. of Nat. Hist., vol. iii, p. 271, fig. 2, 1830.

— ESCHAROÏDES, *De Blainville*, Dict. Sc. Nat. Atlas (Zooph.), pl. xliii, fig. 5, 1830.

—Man., pl. lxv, fig. 5.

HALYSITES DICHOTOMA, ATTENUATA and MACROSTOMA, *Fischer*, Oryct. de Moscou, pl. xxxviii, figs. 1, 2, 4, 1830.

- CATENIPORA LABYRINTHICA, *Morren*, Descr. Cor. Belg., p. 68, 1832.
- — *St. Kutorga*, Beitr. zur Geogn. und Paleont., Dorpat's, p. 23, tab. v, fig. 1, 1835.
- HALYSITES LABYRINTHICA, *Bronn*, Leth. Geogn., vol. i, p. 52, tab. v, fig. 8, 1835.
- CATENIPORA LABYRINTHICA, *Milne Edwards*, in Lamk., 2d edit., vol. ii, p. 322, 1836.
- HALYSITES LABYRINTHICA, *Fischer*, Oryct. de Moscou, 2d edit., p. 163, pl. xxxviii, figs. 1, 2, 4, 1837.
- CATENIPORA LABYRINTHICA, *Hisinger*, Leth. Suec., p. 95, tab. xxvi, fig. 10, 1837.
- ESCHAROÏDES, *Lonsdale*, in Murchison, Silur. Syst., p. 685, pl. xv bis, fig. 14, 1839.
- LABYRINTHICA, *Eichwald*, Sil. Syst. in Esthland, p. 199, 1840.
- ESCHAROIDES, *Hall*, Geol. of New York, 4th part, No. 22, fig. 1, 1843.
- AGGLOMERATA, *Ibid.*, No. 22, fig. 2.
- LABYRINTHICA, *Castelnau*, Terr. Sil. de l'Amer. Sept., p. 45, pl. xvii, fig. 1, 1843.
- MICHELINI, *Ibid.*, p. 45, pl. xvii, fig. 2.
- ESCHAROIDES, *Portlock*, Rep. on the Geol. of Londonderry, &c., p. 325, pl. xx, fig. 9, 1843.
- — *Dale Owen*, Rep. on Geol. of Iowa, &c., p. 33, pl. vii, fig. 2, 1844.
- HALYSITES LABYRINTHICA, *Keyserling*, Reise in Petschora, p. 175, 1846.
- CATENIPORA GRACILIS, *Milne Edwards* and *Jules Haime*, Atlas du Regne Anim. de Cuvier (Zooph.), pl. lxx bis, fig. 2, 1849.
- COMPRESSA, *Ibid.*, pl. lxx bis, fig. 3.
- HALYSITES LABYRINTHICA, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 50, 1850.
- AGGLOMERATA, *Ibid.*, p. 50.
- CATENULARIA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 281, 1851.
- CATENULATUS (pars), *M'Coy*, Brit. Palæoz. Foss., p. 26, 1851.
- CATENIPORA ESCHAROÏDES, *J. Hall*, Paleont. of New York, vol. ii, pp. 44 and 127, pl. xviii, fig. 2, and pl. xxxv, fig. 1, 1852.
- AGGLOMERATA? *Ibid.*, p. 129, pl. xxxv bis, fig. 2.

Corallum very tall, forming a loose convex mass, composed of large vertical plates, that are themselves made up with single series of tubular corallites united laterally. These plates meet so as to form various angles, and to constitute, at the surface of the mass, large irregular reticulations; the divisions of which are much larger in one direction than in the other. The sides of the reticulations are composed of a series of corallites, varying in number from three to eight. *Calices* elliptical, and of the same size in the same specimen, but varying very much in different specimens (their great diameter varying from almost half a line to above $1\frac{1}{2}$ line). Walls strong, and covered with a thick epitheca. Septa trabicular (12), reaching almost to the centre of the visceral chamber. Tabulæ well developed, horizontal, and closely set.

Llandeilo flags: Robeston Walshen, Pembrokeshire. Sholeshook, Pembrokeshire (Murchison).

Caradoc sandstone: Hughley, Salop, Lickey (Murchison).

Wenlock limestone: Much Wenlock, Dudley, Aymestry, Benthall Edge. Lincoln Hill, Townhope, Little Ridge, Easthope, Malvern (Murchison).

Middle Ludlow rocks: Aymestry, Tatter Edge near Downton-on-the-Rock (Murchison).

In Ireland, Col. Portlock mentions its existence at Desertcreat, Tyrone, and at Portrane, Dublin; and Professor M'Coy in a great number of localities in the counties of Galway, Kildare, Kerry, Mayo, Tyrone, and Dublin.

This coral is also met with in Bohemia, Sweden, Norway, Russia, and North America.

Specimens are in the Collections of the Geological Society of London, of the Museum of Practical Geology, &c.

Mr. Hall has separated from this species some specimens, under the name of *H. agglomerata*,¹ confined in the upper part of the Niagara limestone, in Sweden and Ogden, Monroe county, and in which the reticulations are proportionally smaller; but the numerous gradations that we observed between these forms, induced us to consider them as being only varieties of the same species. We must even add that the distinction between *H. catenularia* and *H. escharoides* is not as yet clearly established; the principal difference between them consisting only in the form of the reticulations, which are much more regular and of more equal dimensions in *H. escharoides*.

2. HALYSITES ESCHAROIDES. Tab. LXIV, figs. 2, 2a.

FUNGITE, *G. W. Knorr* and *J. E. E. Walch*, Rec. des Monum. des Catastr., vol. ii, pl. f ix, figs. 1, 2, 3, 1775.

CORALLITE, *Ibid.*, vol. iii, Suppl., p. 158, pl. vi a, 1775.

MADREPORA CATENULARIA, *Esper*, Pflanz. (Petref.), tab. v.

TUBIPORA CATENULATA? *Parkinson*, Org. Rem., vol. ii, pl. iii, fig. 4, 1808.

CATENIPORA ESCHAROIDES, *Lamarck*, Hist. des An. sans Vert., vol. ii, p. 207, 1816; 2d edit., p. 322.

TUBIPORITES CATENULARIA, *Wahlenberg*, Nov. Act. Soc. Scient. Upsal., vol. viii, p. 99, 1821.

CATENIPORA ESCHAROIDES, *Lamouroux*, Exp. Meth., p. 65, 1821.

— — *Krüger*, Gesch. der Urw., vol. ii, p. 264, 1823.

— — *Lamouroux*, Encycl. (Zooph.), p. 177, 1824.

— — *Goldfuss*, Petref. Germ., vol. i, p. 74, pl. xxv, fig. 4, 1826.

HALYSITES JACOWICKYI, *Fischer*, Not. sur des Tubip. Foss., p. 15, figs. 5 and 6, 1828.

CATENIPORA ESCHAROIDES, *Eichwald*, Zool. Spec., vol. i, p. 192, 1829.

— EXILIS, *Ibid.*, p. 193, tab. ii, fig. 13.

— RETICULATA, *Ibid.*, p. 192, tab. ii, fig. 11.

— ESCHAROIDES, *De Blainville*, Dict. Sc. Nat. Atlas (Zooph.), pl. xl, fig. 1, 1830; Man. d'Actin., p. lxii, fig. 1.

TUBIPORA CATENULATA, *S. Woodward*, Syn. Table of Brit. Org. Rem., p. 5, 1830.

CATENIPORA ESCHAROIDES, *Holl*, Handb. der Petref., p. 412, 1830.

¹ Geology of New York, 4th part, No. 22, fig. 2.

- CATENIPORA ESCHAROIDES, *Steininger*, Mém. Soc. Géol. de France, vol. i, p. 341, 1831.
 — — — *Morren*, Descr. Corall. Belg., p. 68, 1832.
 HALYSITES ESCHAROÏDES, *Fischer*, Oryct. de Mosc., p. 164, pl. xxxviii, fig. 3, 1837.
 CATENIPORA ESCHAROIDES, *Hisinger*, Leth. Suec., p. 94, tab. xxvi, fig. 9, 1837.
 — — — *Eichwald*, Sil. Syst. in Esthl., p. 199, 1840.
 — — — *Castelnau*, Terr. Sil. de l'Amer. du Nord., p. 45, pl. xvii, fig. 3, 1843.
 HALYSITES ESCHAROÏDES, *Geinitz*, Grundr. der Verst., p. 581, pl. xxiii A, fig. 11, 1845-46.
 — CATENULATA, *Keyserling*, Reise in Petsch., p. 175, 1846.
 — ESCHAROÏDES, *D'Orbigny*, Prodr. de Pal., vol. i, p. 50, 1850.
 — CATENULATA, *Ibid.*, p. 109.
 — ESCHAROÏDES, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 284, 1851.

Reticulations of the upper surface of the *corallum* small and polygonal; their sides in general formed by only 2 or 3 corallites. *Calices* elliptical, and about half a line broad in the direction of the series of individuals, but much less in the other. 12 *septa*. *Tabulæ* strong and closely set.

Found at Benthall Edge; in Gothland, in Groningue, Russia, and North America.

Specimens are in the Collections of M. Bouchard-Chantreaux, the Museum of Paris, &c.

6. Genus SYRINGOPORA, (p. lxii.)¹

1. SYRINGOPORA BIFURCATA. Pl. LXIV, figs. 3, 3a, 3b.

- TUBIPORITES FASCICULARIS? *Wahlenberg*, Nov. Act. Soc. Ups., vol. viii, p. 99, 1821. (Not Linné.)
 AULOPORA SERPENS? *Ibid.* A young specimen.
 SYRINGOPORA RETICULATA, *Hisinger*, Leth. Suec., p. 95, tab. xxvii, fig. 2, 1837. (Not Goldf.)
 AULOPORA SERPENS, *Ibid.*, p. 95, tab. xxvii, fig. 1. A young specimen?
 SYRINGOPORA RETICULATA, *Lonsdale*, in Murchison, Silur. Syst., p. 684, pl. xv bis, fig. 10, 1839.
 — BIFURCATA, *Ibid.*, p. 685, pl. xv bis, fig. 11.
 HARMODITES CATENATUS (pars), *Geinitz*, Grundr. der Verst., p. 565, 1845-46.
 — BIFURCATA, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 50, 1850.
 SYRINGOPORA BIFURCATA, *M'Coy*, Brit. Palæoz. Foss., p. 27, 1851.
 — — — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 287, 1851.

Corallites straight, or slightly geniculated at the places where the connecting tubes arise; separated from each other at a distance equal to once or twice their diameter. Connecting tubes large, often somewhat ascendant, and placed at about two lines apart. Diameter of the corallites one third or one line.

¹ Under the name of Harmodites.

Found at Dudley; at Gleedon Hill and Wenlock (Murchison); in Groningue, and in Gothland.

Specimens in the Collections of Mr. Fletcher, of Mr. Bowerbank, of the Geological Society, of the Paris Museum, &c.

2. SYRINGOPORA FASCICULARIS. Tab. LXV, figs. 1, 1a, 1b, 1c.

TUBIPORA FASCICULARIS, *Linné*, Syst. Nat., edit. 12, p. 1271, 1767.

— — — *Othon Fabricius*, Fauna Groenl., p. 429, 1788.

SYRINGOPORA FILIFORMIS, *Goldfuss*, Petref. Germ., vol. i, p. 113, tab. xxxviii, fig. 16, 1829.

— — — *Morren*, Descr. Cor. Belg., p. 70, 1832.

AULOPORA SERPENS, *De Blainville*, Man. d'Actin., pl. lxxxi, fig. 1, 1834.

SYRINGOPORA FILIFORMIS, *Milne Edwards*, in Lamarck, Hist. des Anim. sans Vert., 2d edit. vol. ii, p. 328, 1836.

— — — *Lonsdale*, in Murchison, Silur. Syst., p. 685, pl. xv bis, fig. 12, 1839.

AULOPORA TUBÆFORMIS, *Ibid.*, p. 676, pl. xv, fig. 8; and, perhaps, also AULOPORA SERPENS, *Ibid.*, p. 675, pl. xv, fig. 6.

HARMODITES FILIFORMIS, ANGLICA, and IRREGULARIS, *D'Orbigny*, Prodr. de Paléont., vol. i, pp. 50, 51, 1850.

SYRINGOPORA FASCICULARIS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 293, 1851.

Corallum, when very young, rampant, and presenting short prominent calicular tubes, so as to resemble very closely *Aulopora*; but by the progress of age these calicular tubes become very tall, and multiply by lateral gemmation, so as to form a fasciculated, cespitose mass, in which the corallites are rather closely set, being placed at a distance equal to once or twice their diameter, which is itself about one third of a line. *Walls* very thick, and covered with a strong epitheca. Corallites but slightly geniculated, geminating frequently, and united by only few large connecting tubes.

Found at Dudley, Dorming Wood, Benthall Edge, Gleedon Hill. Sir Roderick Murchison has found it in the Wenlock limestone at Eastnor Park, Ledbury, Prescoed Common, Usk, Aston Ingham near Newent, and in the Ludlow rocks at Ristley Wood, near Newent.

It is also met with in Gothland and Groningue.

This species is remarkable by its corallites being very slender and straight, or slightly geniculated, and by the large diameter of the connecting tubes. It much resembles *S. exilis*,¹ in which the corallites are, however, more flexuous and more closely set.

The resemblance which the young specimens of this species bear to *Aulopora* is so great, that many authors have referred them to that generical division. But in different

¹ *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 295.

parts of the same specimen, and sometimes also in different specimens, we have observed the intermediate form between this state and the fasciculated structure peculiar to *Syringopora*.

3. *SYRINGOPORA SERPENS*. Tab. LXV, figs. 2, 2a.

MADREPORA TUBULIS, &c., *Fougé*, Amæn. Acad., vol. i, p. 105, tab. iv, figs. 22, 26, 1749.

TUBIPORA SERPENS, *Linné*, Syst. Nat., edit. 12, p. 1271, 1767.

— — *Othon Fabricius*, Fauna Groenl., p. 428, 1788.

CATENIPORA AXILLARIS, *Lamarck*, Hist. des Anim. sans Vert., vol. ii, p. 207, 1816; 2d edit., p. 322.

— — *Lamouroux*, Exp. Meth., p. 66, 1821.

TUBIPORITES SERPENS, *Krüger*, Gesch. der Urw., p. 263, 1823.

CATENIPORA AXILLARIS, *Lamouroux*, Encycl. (Zooph.), p. 177, 1824.

AULOPORA CONGLOMERATA, *Lonsdale*, in Murchison, Silur. Syst., p. 675, pl. xv, fig. 3, 1839. (Not Goldfuss.)

— *LONSDALEI*, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 51, 1850.

SYRINGOPORA SERPENS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 294, 1851.

Young specimens of this coral equally resemble *Aulopora*; by the progress of age and the multiplication of individuals, the corallites become very tall and closely set. *Epitheca* strong. *Walls* thick. 18 *septal striæ*. Connecting tubes few in number. Diameter of the corallite somewhat more than half a line.

Dudley and Benthall Edge. Gothland.

Specimens are in the Collections of Mr. Fletcher, of the Museum of Paris, &c.

This species differs from the preceding ones by the large size of its corallites, the irregular way in which they are set, and the extreme rarity of the connecting tubes.

Syringopora Lonsdaleana,¹ which Professor M'Coy found in the Silurian beds of Portrane and Mahahide, county of Dublin, is evidently distinct from the three Silurian species here described, but is so imperfectly known that it appears difficult to characterise it. The corallites are large, straight, and irregularly placed. The connecting tubes are large, and appear to be very short.

Syringopora cæspitosa, *Lonsdale*, in Murchison, Silur. Syst., pl. xv bis, fig. 13 (not Goldfuss); *Harmodites Lonsdalei*, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 50; is a coral from Wenlock, which is entirely unknown to us, and seems not to belong to the genus *Syringopora*.

¹ M'Coy, Syn. of Sil. Foss. of Irel., p. 65, pl. iv, fig. 20, 1846.

7. Genus CÆNITES.¹

1. CÆNITES JUNIPERINUS. Tab. LXV, figs. 4, 4a.

CÆNITES JUNIPERINUS, *Eichwald*, Zool. Spec., vol. i, p. 179, 1829.

LIMARIA CLATHRATA, *Lonsdale*, in Murchison, Sil. Syst., p. 692, pl. xvi bis, figs. 7, 7a, 1839. (Not Steininger.)

— LONSDALEI, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 49, 1850.

CÆNITES JUNIPERINUS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 301, 1851.

LIMARIA RAMULOSA, *J. Hall*, Palæont. of New York, vol. ii, p. 142, pl. xxxix, fig. 4, 1852.

Corallum dendroid; its branches cylindrical, somewhat flexuous, scarcely ever coalescent. *Calices* closely set, not prominent, much elongated transversely, or even almost linear. The upper margin concave, and presenting a small medial process. The under edge deeply emarginated in the middle, and presenting a small obtuse process on each side. Cœnenchyma not very abundant. Diameter of the branches about 2 lines; large diameter of the calices about two fifths of a line; and about four times their diameter in the opposite direction.

Dudley and Russia. Mr. Hall mentions its existence at Lockport, Niagara county.

Specimens are in the Collections of Mr. Fletcher and M. de Verneuil.

It is not without some hesitation that we place the genus Cœnites in the class of Polypi; the form of the calices resembling very much what is met with in certain Bryozoa. In the present state of our knowledge concerning the structure of these fossils, their zoological affinities cannot be determined with certainty, but we are inclined to think that they are allied to the Favositidæ.

*C. intertextus*² resembles *C. juniperinus* in its dendroid form, but differs from it in the form of the calices.

2. CÆNITES INTERTEXTUS. Tab. LXV, figs. 5, 5a.

CÆNITES INTERTEXTUS, *Eichwald*, Zool. Spec., vol. i, p. 179, pl. ii, fig. 16, 1829.

LIMARIA FRUTICOSA, *Lonsdale*, in Murchison, Silur. Syst., p. 692, pl. xvi bis, figs. 7b, 8, 8a, 1839. (Not Steininger.)

CÆNITES INTERTEXTUS, *M'Coy*, Brit. Palæoz. Foss., p. 22, 1851.

— — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 302, 1851.

Corallum ramose; branches cylindrical, not coalescent. *Calices* not very closely set, very prominent, their opening narrow, subtriangular, and presenting three small obtuse

¹ *Eichwald*, Zool. Spec., vol. i, p. 179, 1829.—*Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 301, 1851.

² See tab. lxx, fig. 5.

denticulations. Diameter of the branches two or three lines ; large diameter of the calices about one fourth of line ; small diameter about one eighth.

Dudley. Sir Roderick Murchison has found it at Wenlock, Ledbury, Lincoln Hill, and Coalbrook Dale, Nasch Scar, Presteign, Abberley Hills. Aymestry, Herefordshire (M'Coy). Russia (Eichwald).

This species is well characterised by its prominent mammilar calices, and by the peculiar form of their terminal aperture. *C. fruticosus*,¹ found by M. Steininger in the Devonian formation of the Eifel Mountains, to which Mr. Lonsdale referred this coral, much resembles it in its general form, but differs from it by the oblique direction of its calicular apertures.

3. CÆNITES LINEARIS. Tab. LXV, fig. 3.

CÆNITES LINEARIS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 302, 1851.

Corallum massive, convex or subgibbose, and composed of thin superposed layers. *Calices* closely set, not prominent, or but very slightly so, linear, with their margin very obscurely denticulated, about half a line broad and one twelfth in the contrary direction.

Dudley. Collection of Mr. Fletcher.

This species differs greatly from the preceding ones, by its massive form, and its completely linear calices.

4. CÆNITES LABROSUS. Tab. LXV, figs. 6, 6a.

CÆNITES LABROSUS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus. vol. v), p. 302, 1851.

Corallum lamellar, cyathoid, and pedunculated ; its under surface granulose, and resembling that of a rasp ; each tubercle being terminated on its upper side by an almost semilunar aperture, the under lip of which is prominent, slightly emarginated in the middle, and almost covers the aperture. The medial denticulations of the upper lip not much developed ; breadth of the calices about one third of a line. The upper surface is completely covered by extraneous matter in both specimens that we have seen.

Dudley. Collection of Mr. Fletcher.

This coral differs from all the other species of the same genus in general form, and in the peculiar disposition of the under lip which hides the marginal denticulation of its calices.

¹ *Limaria fruticosa*, Steininger, Mém. Soc. Géol. de France, vol. i, p. 339, 1831.

5. CÆNITES? STRIGATUS.

CÆNITES STRIGATUS, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 280, 1850.

— — *M'Coy*, Brit. Palæoz. Foss., p. 22, pl. i c, fig. 8, 1851.

“*Corallum* forming cylindrical, dichotomous branches, two to three lines in diameter; surface with small, narrow, triangular cells, the base of the triangle below, and the apex usually more or less prolonged upwards into a vermiform channel, often upwards of half a line long; four to five rows of cells in the space of one line measured transversely, about two in the same space measured longitudinally; compact interstitial space between the rows of cell-openings usually rather exceeding their width.

“In the Wenlock limestone of Dudley, Staffordshire.” *M'Coy*, loc. cit.

Family THECIDÆ, (p. lxiii.)

Genus THECIA, (p. lxiii.)

1. THECIA SWINDERNANA. Tab. LXV, figs. 7, 7a.

AGARICIA SWINDERNIANA, *Goldfuss*, Petref. Germ., vol. i, p. 109, pl. xxxviii, fig. 3, 1829.

— — *Morren*, Descr. Cor. Belg., p. 46, 1832.

PORITES EXPATIATA, *Lonsdale*, in Murchison, Silur. Syst., p. 687, pl. xv, fig. 3, 1839.

— SWINDERNANA, *Bronn*, Ind. Paléont., p. 1031, 1849.

ASTREOPORA EXPATIATA, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 50, 1850.

PALÆOPORA? (THECIA) EXPATIATA, *M'Coy*, Brit. Palæoz. Foss., p. 14, 1851.

THECIA SWINDERNANA (Introd., pl. lxiii, 1850), *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 306, 1851.

Corallum massive, subgibbose, not very thick; its under surface covered with a thin wrinkled epitheca, and sometimes free, sometimes adherent in the middle; upper surface covered with small superficial calices, which vary in size and form—the larger ones placed on the prominent part of the tuberosities, the other in the depressions; most of them circular, some polygonal; most of them confluent, some separated by a slight furrow. Septa varying in number from 12 to 18, well developed, rather thick, slightly flexuous, closely set, terminated by horizontal upper edge, and not extending quite to the centre of the calice, where a small shallow circular fossula is visible, but where we have not been able to discover any columella. These septa are somewhat unequal in breadth alternately, but are all of equal thickness, and are prolonged externally under the form of horizontal costal ridges. A vertical section shows that the visceral chambers are separated by an abundant compact spurious cœnenchyma, resulting from the intimate union of the costæ.

Tabulæ horizontal, strong, and occupying only the central part of the visceral chambers, where the septo-mural tissue does not extend. Breadth of the calices about half a line.

Dudley, Benthall Edge; Lincoln Hill, Coalbrook Dale, Aston Ingham near May Hill, Lindells, and Woolhope (Murchison); Gothland and Groningue.

Specimens in the Collections of the Bristol Museum, of the Geological Society, of the Museum of Practical Geology, of Mr. Fletcher, &c.

2. *THECIA* GRAYANA. Tab. LXV, fig. 8.

THECIA GRAYANA, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 307, 1851.

Corallum massive, thin, adherent; basal surface covered with a very thick, circularly wrinkled epitheca. Calices subequal, not prominent, and presenting a rather deep, circular central fossula. 12 septa, equally developed, closely set, very thick, subconfluent exteriorly, and bearing on their upper edge a double row of granulations. Diameter of the calices about half a line.

Dudley. Collection of Mr. J. Gray.

This species differs from the preceding one by the lesser number of the septa.

Family CYATHAXONIDÆ, (p. lxv.)

Genus CYATHAXONIA, (p. lxv.)

CYATHAXONIA? SILURIENSIS.

CYATHAXONIA SILURIENSIS, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 281, 1850.

— — *M'Coy*, Brit. Palæoz. Foss., p. 36, pl. i c, fig. 11, 1851.

“*Corallum* elongate-conic, about 5 lines long and 2 lines in diameter at the height from the base; strong central axis, nearly one third of the diameter; 60 or 70 strong radiating lamellæ, each extending from the axis to the outer wall, before reaching which it bifurcates, leaving a triangular interlamellar space, about equal in width to the distance between the adjoining lamellæ; surface coarsely ridged longitudinally, the sulci corresponding to the divided edges of the lamellæ, leaving one of the equal intervening ridges to correspond with each of the spaces between the individual lamellæ and between their divided edges.

“Rare in the upper Ludlow rock of Underbarrow, Kendal, Westmoreland.” *M'Coy*, loc. cit.

Family CYATHOPHYLLIDÆ, (p. lxv.)

1. *Genus* AULACOPHYLLUM, (p. lxvii.)AULACOPHYLLUM MITRATUM. Tab. LXVI, figs. 1, 1*a*, 1*b*.HIPPIURITES MITRATUS (pars), *Schlotheim*, Petref., 1st part, p. 352, 1820.TURBINOLIA OBLIQUA, *Hisinger*, Anteckningar, vol. v, p. 128, pl. viii, fig. 7, 1831.— FURCATA, *Ibid.*, p. 128, tab. vii, fig. 4.— MITRATA, *Hisinger*, Leth. Suec., p. 100, pl. xxviii, fig. 10 (var. *obliqua*), and fig. 11 (var. *furcata*), 1837.CYATHOPHYLLUM MITRATUM, *Geinitz*, Grundr. der Verst., p. 571, pl. xxxiii A, fig. 8, 1845-46.PETRAIA ÆQUISULCATA, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 279, 1850.— — *M'Coy*, Brit. Palæoz. Foss., p. 39, 1851.AULACOPHYLLUM MITRATUM, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 356, pl. ii, fig. 6, 1851.

Corallum simple, turbinated, free, subpedicillated, thin, strongly curved; epitheca thin, and presenting slight circular wrinkles. 34 principal septa, rather thick exteriorly, extending mostly to the centre of the visceral chamber, and alternating with an equal number of rudimentary ones. A furrow occupying the place of the septal fossula, not well defined, and indicated by the junction of the septa at the bottom of the calices. Height of the corallum $1\frac{1}{2}$ or 2 inches; diameter of the calice about 8 lines.

Dudley, Walsall. Professor M'Coy mentions also its existence at Coniston, Lancashire; Applethwaite Common, Westmoreland; Mulock Quarry, Dalquorhan near Girvan, Ayrshire; High Haime, Dalton in Furness, Lancashire; Glyn Ceiriog, Denbighshire.

This coral is also met with in Gothland. It does not present the characteristic peculiarities of *Aulacophyllum* in as distinct a manner as the other species of the same genus; but in adult specimens the pinnate arrangement of the septa is very evident. In *A. sulcatum*¹ they are much more numerous.

2. *Genus* CYATHOPHYLLUM, (p. lxviii.)1. CYATHOPHYLLUM? LOVENI. Tab. LXVI, figs. 2, 2*a*.MADREPORA SIMPLEX, &c., var. δ , *Fougè*, Amæn. Acad., vol. i, p. 90, tab. iv, fig. 4, 1749.FUNGITES, *Thomas Pennant*, Phil. Trans., vol. xlix, 2d part, p. 515, tab. xv, figs. 8 and 9, 1757.CYATHOPHYLLUM FLEXUOSUM? *Hisinger*, Leth. Suec., p. 102, pl. xxix, fig. 3, 1837. (Not Goldfuss.)¹ Pol. Foss. des Terr. Palæoz., p. 355, pl. vi, fig. 2.

TRYPLASMA ARTICULATA, *Lonsdale*, in Murchison, Vern., and Keys., Russ. and Ural, vol. i, pl. A, fig. 8, 1845. (Not *Cyathophyllum articulatum*, Hisinger.)

CYATHOPHYLLUM? LOVENI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 364, 1851.

Corallum simple, or accidentally aggregate, very tall, nearly cylindrical, subpedicillated, and slightly curved near its basis. The differences in the degree of activity in the development of the polyp are so very great, that the corallum presents an alternate series of circular constrictions and prominent ridges, and has somewhat the appearance of a pile of cyathiform corallites. Costæ rather thick, equally developed and flat. Calice circular, rather shallow. Septa about 60 in number, alternately large and small, closely set, and bearing numerous strong marginal denticulations. The small septa correspond to the middle of the costæ, and the large ones to the intercostal furrows. Height about 12 or 15 lines; breadth of the calice 4 or 5 lines; depth about 2 lines.

Found at Wren's Nest near Dudley; and in Gothland.

Specimens in the Collections of M. de Verneuil and M. Bouchard-Chantreaux.

This species is easily recognised by its prominent circular accretion ridge, which gives to it a lamellated appearance, much resembling that of *Chonophyllum*; it differs, however, from this genus by the great development of the septal apparatus.

We are inclined to think that the fossil coral found by Professor M'Coy at Egool and Bellagherreen, in the county of Mayo, and referred by that palæontologist to *Cyathophyllum flexuosum* of Goldfuss, belongs to this species.

2. CYATHOPHYLLUM ANGUSTUM. Tab. LXVI, figs. 4, 4a.

CYATHOPHYLLUM ANGUSTUM, *Lonsdale*, in Murchison, Silur. Syst., p. 690, pl. xvi, fig. 9, 1839.

— — *D'Orbigny*, Prodr. de Paléont., vol. i, p. 47, 1850.

CYSTIPHYLLUM BREVILAMELLATUM, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser. vol. 6, p. 276, 1850.

— — *M'Coy*, Brit. Palæoz. Foss., p. 32, pl. i B, fig. 19, 1851.

CYATHOPHYLLUM ANGUSTUM, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 365, 1851.

Corallum simple, straight, tall, somewhat compressed (may be accidentally), and presenting but few feebly developed accretion ridges; septa very thin, placed about half a line apart, and united by strong dissepiments, so that when the epitheca is worn away (as in the specimen here figured) the surface of the corallum appears covered with regular square cells. A vertical section shows that the tabulæ are small, closely set, somewhat irregular, and occupy only one fourth or one fifth of the diameter of the corallum; the rest being filled up with vesicular cells that are placed obliquely, and are about half a line broad. The height of the corallum was probably about four inches; diameter about $1\frac{1}{2}$ inch.

Found in the Wenlock shale at Atwoods Shaft, Lickey.

Mr. Lonsdale mentions its existence in the Caradoc sandstone of Coal Moors, Lickey.

A specimen is in the Collection of the Geological Society.

This coral differs from most of the other species of *Cyathophyllum* by the small extent of the tabulæ. This structural character is also met with in *C. damnoniense*¹ and *C. Stutchburyi*.² The above-described fossil differs from the first of these by the vesicles being much more regular; and from the second by the absence of large cells between the space occupied by the tabulæ and that occupied by the vesicular tissue. It differs also from both these species by septa being much less numerous.

3. CYATHOPHYLLUM PSEUDO-CERATITES. Tab. LXVI, figs. 3, 3a, 3b.

MADREPORA SIMPLEX, &c., var. *ε*, *Fougé*, Amæn. Acad., vol. i, p. 90, tab. iv, fig. 7, 1749.

FUNGITES, *Thomas Pennant*, Philos. Trans., vol. xlix, 2d part, p. 514, tab. xv, fig. 7, 1757.

STREPHODES PSEUDO-CERATITES, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 275, 1850.

— — *M'Coy*, Brit. Palæoz. Foss., p. 30, pl. i b, fig. 20, 1851.

CYATHOPHYLLUM RECURVUM, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 368, 1851.

Corallum simple, turbinated, becoming subcylindrical by the progress of age, very narrow at its basis, strongly curved, and covered with a rather thick epitheca. Accretion ridges not very large. Calice suboval, deep, and presenting rudimentary septal fossula, situated on the side corresponding to the convex part of the corallum. 38 well-developed thin septa, alternating with an equal number of smaller ones. Height of the corallum about 2 inches; breadth of the calice about 8 lines; depth 5 or 6 lines.

Dudley, Wenlock. Old Radnor, Presteign, Radnorshire; Sedgley (*M'Coy*). It is also met with in Gothland.

C. ceratites,³ to which Professor *M'Coy* compares this species, differs from it by its general form, its numerous septa, and its calice, which is almost polygonal.

The coral found by Col. Portlock at Desertcreat, in the county of Tyrone, and referred by that geologist to the *Turbinolopsis elongata* of Phillips, appears to belong to this species.

4. CYATHOPHYLLUM ARTICULATUM. Tab. LXVII, figs. 1, 1a.

MADREPORA TURBINATA (pars), *Esper*, Pflanz. (Petref.), tab. iii, figs. 3 and 4.

MADREPORITES ARTICULATUS, *Wahlenberg*, Nov. Act. Soc. Upsal., vol. viii, p. 87, 1821.

CYATHOPHYLLUM VERMICULARE, *Hisinger*, Anteckn., vol. v, p. 130, tab. viii, fig. 8, 1831.
(Not Goldfuss.)

See tab. iv, fig. 1.

² See tab. xxxiii, fig. 4.

³ See tab. iv, fig. 2.

- LITHODENDRON CÆSPITOSUM, *Ch. Morren*, Descr. Cor. Belg., p. 47, 1832. (Not Goldfuss.)
 CYATHOPHYLLUM VERMICULARE, *Hisinger*, Leth. Suec., p. 102, pl. xxix, fig. 2, 1837.
 — ARTICULATUM, *Ibid.*, p. 102, pl. xxix, fig. 4.
 — CÆSPITOSUM, *Lonsdale*, Sil. Syst., p. 690, pl. xvi, fig. 10, 1839. (Not Goldfuss.)
 — DIANTHUS (pars)? *Lonsdale*, *Ibid.*, pl. xvi, fig. 12e (*Cæt. excl.*) (Not Goldfuss.)
 — CÆSPITOSUM, *Eichwald*, Sil. Syst. in Esthland, p. 203, 1840.
 — — *D'Orbigny*, Prodr. de Paléont., vol. i, p. 47, 1850.
 STREPHODES CRAIGENSIS, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 275, 1850.
 — — *M'Coy*, Brit. Palæoz. Foss., p. 30, pl. i c, fig. 10, 1851.
 CYATHOPHYLLUM ARTICULATUM, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 377, 1851.

Corallum composite, fasciculate; corallites closely set, subcylindrical, tall, presenting numerous prominent accretion ridges, and covered with a thin epitheca, through which the costæ are apparent. *Calices* circular, shallow. Septa about sixty in number, thin, equally developed, and somewhat closely set. Gemmation often very distinctly intracalicular; the young corallites remain cylindrical, and rise side by side without uniting. The tabulæ are small, and irregularly placed. The lateral vesicles are almost as high as broad, and rather irregular in size. The septa are well developed.

Wenlock, Dudley. Craig Head near Girwan, Ayrshire (M'Coy); Gothland and Russia.

Specimens in the Collections of the Geological Society, of Mr. Fletcher, Mr. J. Gray, &c.

This species resembles *C. cæspitosum*¹ and *C. æquiseptatum*,² by the mode of aggregation of its corallites; but differs from them by the great development of its accretion ridges. In that respect it much resembles *C. Loveni*,³ in which the costæ are thicker, and the septa more unequally developed.

We are inclined to think that the *Cladocora sulcata* of Mr. Lonsdale⁴ is only a variety of the species in which the accretion ridges are less prominent. It was found at Benthall Edge, and, according to Professor M'Coy, at Ferriter's Cove and Dingle, in the county of Kerry.

The fossils described by Professor M'Coy under the name of *Cyathophyllum cæspitosum*⁵ appear also to belong to this species, and were found at Ardaun, Cong, in the county of Galway; Chair of Kildare, Kildare, in the county of Kildare; Doonquin, Dingle, in the county of Kerry; Portrane, Malahide, in the county of Dublin.

¹ See tab. li, fig. 2.

² See tab. lii, fig. 2.

³ See tab. lxvi, fig. 2.

⁴ Silur. Syst., p. 692, pl. xvi bis, fig. 9.

⁵ Silur. Foss. of Ireland, p. 61, 1846.

5. CYATHOPHYLLUM TRUNCATUM. Tab. LXVI, figs. 5, 5a, 5b, 5c.

FUNGITÆ OCTO MAJORES, &c., *Magnus Bromel*, Acta Liter. Suec., vol. ii, p. 465, 1728.

PORPITARUM PLURIUM, &c., *Ibid.*, pp. 466 and 467, figs. 1—5, 1728.

MADREPORA COMPOSITA, &c., *Fougé*, Amæn. Acad., vol. i, p. 93, tab. iv, fig. 10, 1749.

FUNGITES, *Thomas Pennant*, Phil. Trans., vol. xlix, 2d part, pp. 514 and 516, tab. xv, figs. 6 and 12, 1757.

MADREPORA TRUNCATA, *Linné*, Syst. Nat., edit. 10, p. 795, 1758.

— — *Linné*, Fauna Suec., p. 536, 1761.

— — *Linné*, Syst. Nat., edit. 12, p. 1277, 1767.

STROMBODES TRUNCATUS, *Schweigger*, Handb. der Naturg., p. 418, 1820.

MADREPORITES TRUNCATUS, *Wahlenberg*, Nov. Act. Soc. Upsal., vol. viii, p. 97, 1821.

STROMBODES TRUNCATUS, *Eichwald*, Zool. Spec., vol. i, p. 188, 1829.

FLOSCULARIA COROLLIGERA, *Ibid.*, p. 188, pl. xi, fig. 4.

STROMBASTRÆA TRUNCATA, *De Blainville*, Dict. des Sc. Nat., vol. lx, p. 342, 1830.—*Man.*, p. 376.

CARYOPHYLLIA EXPLANATA, *Hisinger*, Anteckningar, vol. v, p. 129, tab. viii, fig. 9, 1831.

— — *Hisinger*, Leth. Suec., p. 101, tab. xxviii, fig. 13, 1837.

CYATHOPHYLLUM DIANTHUS, *Lonsdale*, Silur. Syst., p. 690, pl. xvi, figs. 12, 12d (*Cæt. excl.*), 1839. (Not Goldfuss.)

— — *var. PROLIFERA*, *Eichwald*, Silur. Syst. in Esthland, p. 200, 1840.

— TRUNCATUM, *Bronn*, Index Pal., vol. i, p. 370, 1848.

— SUBDIANTHUS, *D'Orbigny*, Prodr. de Pal., vol. i, p. 47, 1850.

STREPHODES VERMICULOIDES, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 275, 1850.

— — *M'Coy*, Brit. Palæoz. Foss., p. 31, pl. i B, fig. 22, 1851.

CYATHOPHYLLUM TRUNCATUM, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 379, 1851.

Corallum composite, forming a tall turbinate mass, the basis of which is occupied by the parent corallite, and the upper surface is convex, and occupied by calices that vary very much in size, and are generally free at their edges, but sometimes meet, and become partially soldered together. Gemmation exclusively calicinal. Corallites regularly turbinate, not very tall, and narrow at their basis. *Walls* covered with a very thin epitheca, and presenting numerous strongly marked accretion ridges. *Calices* circular, or deformed by the pressure of the neighbouring corallites, and terminated by thin, slightly everted edges. Central fossula large, and rather deep; outer part of the calice almost flat. *Septa* (50 or 60) very closely set and thick, towards the circumference, but rather thin towards the centre, rather unequal in length alternately; the largest reaching to the centre. The internal structure of the corallites very dense. The *tabulæ* are small, and not very distinct exteriorly from the regular dissepiments that divide obliquely the interseptal spaces. Height of the corallites 1 or 1½ inch; diameter somewhat less.

It is found at Much Wenlock, and Benthall Edge, Ledbury, Haven near Aymestry, and Wenlock Edge (Murchison); Portrane and Malahide, Dublin (M'Coy). Sweden and Russia.

Specimens are in the Collections of the Bristol Museum, of the Museum of Practical Geology, of the Geological Society of London, of Mr. Bowerbank, M. Bouchard-Chantreaux, and M. de Verneuil.

This coral is remarkable by its mode of gemmation, exclusively calicinal, and by the everted form of its calices.

It most resembles *C. regium*¹ and *C. helianthoides*,² but its septa are thicker and less numerous than in those large corals.

6. CYATHOPHYLLUM FLEXUOSUM. Tab. LXVII, figs. 2, 2a.

MADREPORA COMPOSITA, &c., *Fougé*, Amæn. Acad., vol. i, p. 96, tab. iv, figs. 5 and 13, 1749.

— FLEXUOSA, *Linné*, Syst. Nat., edit. 12, p. 1278, 1767.

CARYOPHYLLIA FLEXUOSA, *Lonsdale*, in Murchison, Sil. Syst., p. 689, pl. xvi, fig. 7, 1839.
(Not Lamarck.)

DIPHYPHYLLUM FLEXUOSUM, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 38, 1850.

CYATHOPHYLLUM FLEXUOSUM, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz.
(Arch. du Mus., vol. v), p. 386, 1851.

Corallum dendroid; gemmation calicular. Corallites cylindrical, tall; epitheca feeble; costal striæ not numerous (about 20). Diameter of the large individuals about 1½ line or 2 lines.

Wenlock Shale, Malvern. Ferriter's Cove and Dingle, Kerry (M'Coy). Gothland.

Specimens are in the Collection of the Geological Society of London.

This species much resembles *C. parricida*,³ in which, however, the corallites are turbinate and the septa less developed.

7. CYATHOPHYLLUM TROCHIFORME.

STREPHODES TROCHIFORMIS, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 275, 1850.

— — *M'Coy*, Brit. Palæoz. Foss., p. 31, pl. i B, fig. 21, 1851.

“*Corallum* simple, slightly curved, widely turbinate; average length one inch three lines, and width at mouth one inch one line, with irregular swellings of growth; outer wall very thin, marked with equal lamellar sulci (6 in 3 lines at one and a quarter inch in diameter, or 83 all round); terminal cup very deep, conical, margin rounded, sides gradually sloping, lined by the thin alternately longer and shorter uneven-edged lamellæ, the longest of which unite, and are irregularly blended at the centre, connected throughout by numerous curved transverse vesicular plates: *horizontal section* shows the same characters as the terminal cup, the alternate lamellæ extending about half way to the

¹ See tab. xxxii, figs. 1, 2, 3, 4.

² See tab. xli, fig. 1.

³ See tab. xxxvii, fig. 1.

centre; *vertical section*, apex filled with solid matter, centre with irregular vermicular lines (the sections of the complicated edges of the radiating lamellæ), from thence to the walls made up of small thick rounded vesicular plates, the obscure rows having a slight downward curve."

"Not uncommon in the Wenlock limestone of Dudley, Staffordshire." M'Coy, *op. cit.*

8. CYATHOPHYLLUM^p VORTEX.

CLISIOPHYLLUM VORTEX, M'Coy, *Ann. and Mag. of Nat. Hist.*, 2d ser., vol. vi, p. 277, 1850.

— — M'Coy, *Brit. Palæoz. Foss.*, p. 33, pl. i B, fig. 18, 1851.

"*Corallum* simple, conic, slightly curved, enlarging at the rate of one inch eight lines in three inches from the apex; outer wall thin, faintly marked with subequal longitudinal lamellar striæ (5 or 6 in the space of 3 lines at a diameter of one inch), and small concentric wrinkles; at a diameter of one inch the horizontal section shows an outer area of about 60 thick, equal, radiating lamellæ, barely reaching one fourth of the diameter towards the centre, connected by small irregular transverse vesicular plates; a few of the pairs have a very thin, short, marginal lamella between each of the larger pairs, and where this occurs the vesicular transverse plates become much more numerous; inner area rather more than half the diameter, forming a circular mass of confused vesicular tissue, crossed by a few arched radiating delicate lamellæ; *vertical section*, having the narrow outer area on each side (corresponding to the lamelliferous zone) of arched vesicular plates, forming large unequal horizontal or slightly inclined cells, 1 or 2 cells extending across the width of the area; wide inner area composed of small oval cells, arranged in much-curved transverse rows, the convexity of the curve upwards.

"Wenlock limestone, Wenlock, Shropshire."—M'Coy, *op. cit.*

Turbinolia fibrosa, Portlock,¹ is a cast found at Desertcreat, and appearing to belong to *Cyathophyllum*, but is not sufficiently characterised to be determined specifically.

The same remark is applicable to the fossil figured by Professor M'Coy under the name of *Petraia zigzag*.² It is a cast of the interior of the visceral chamber of a coral which, in all probability, belongs to the genus *Cyathophyllum*, and had very flexuous costæ. It is found in the Silurian formation at Ardaun, Cong, Galway.

Several other casts that are not determinable specifically, and which have been referred to the non-characterised genus *Turbinolopsis* or *Petraia*, appear also to belong to this group. For example:

Turbinolopsis elongata, Phillips,³ a specimen of which belongs to the Collections of the Geological Society, and found at Leach Heath, Bromsgrove Lickey. We have figured

¹ Report on the Geol. of Londonderry, p. 329, pl. xx, fig. 7.

² Sil. Foss. of Ireland, p. 60, pl. iv, fig. 17.

³ Brit. Palæoz. Foss., p. 6, pl. ii, fig. 6 B, 1841.

it in this Monograph (Tab. LXVI, figs. 6, 6a), in order to give an exact idea of the form of such casts.

Petraia elongata, M'Coy,¹ from Bala, Merionethshire.

Petraia subduplicata, M'Coy.²

Petraia serialis, M'Coy.³

Turbinolopsis rugosa, Phillips,⁴ from Snowdon.

3. Genus OMPHYMA (p. lxviii).

1. OMPHYMA TURBINATA. Tab. LXIX, figs. 1, 1a.

FUNGITES GOTHLANDICUS, &c., *Magnus Bromel*, Act. Liter. Suec., vol. ii, p. 461, 1728.

— MAJOR, &c., *Ibid.*, p. 462.

MADREPORA SIMPLEX, TURBINATA, &c., *Fougé*, Amæn. Acad., vol. i, p. 87, tab. iv, figs. 1, 2 (*Cæt. excl.*), 1749.

— TURBINATA, *Linné*, Fauna Suec., p. 536, 1761.

— — *Linné*, Syst. Nat., ed. 12, p. 1272, 1767.

— — *Esper*, Pflanz. (Petref.), tab. ii, figs. 1, 2 (*Cæt. excl.*).

TURBINATED MADREPORITE, *Parkinson*, Org. Remains, vol. ii, pl. iv, fig. 2, 1808.

TURBINOLIA TURBINATA (pars), *Lamarck*, Hist. des Anim. sans Vert., vol. ii, p. 231, 1816 ; 2d edit., p. 360.

— CYATHOIDES, *Lamarck*, *Ibid.*, p. 231.

MADREPORITES TURBINATUS (pars), *Wahlenberg*, Nov. Act. Soc. Upsal., vol. viii, p. 96, 1821.

TURBINOLIA CYATHOIDES and TURBINATA, *Lamouroux*, Exp. Meth., p. 51, 1821.

— — *Deslongchamps*, Encyc. (Zooph.), p. 750, 1824.

— — *Defrance*, Dict. Sc. Nat., vol. lvi, p. 91, 1828.

CARYOPHYLLIA TURBINATA (pars), *Al. Brongniart*, Tabl. des Terrains, p. 431, 1829.

CANINIA LATA, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 277, 1850.

— — *M'Coy*, Brit. Palæoz. Foss., p. 28, pl. i c, fig. 13, and perhaps also fig. 12, 1851.

OMPHYMA TURBINATA, *Milne Edwards* and *Jules Haime* (Introd., p. lxviii, 1850), Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 400, 1851.

Corallum simple, turbinate, straight, short, often twice as broad as high, subpedicillated, and bearing radicleform appendices in its lower half only. Epitheca thin, and presenting in general only slight accretion wrinkles. Calice subcircular; its edge slightly lamellated. Calicinal cavity large and deep; the uppermost *tabula* presenting an extensive smooth surface in the middle, and four well-characterised septal fossulæ, two of which are larger than the others. *Septa* (100 or 120) thin, not tall, and resembling simple folds, somewhat unequal in dimensions alternately, straight or slightly flexuous towards the centre of the calice. The lower *tabulæ* are horizontal, broad, and well developed. The lateral parts of

Brit. Palæoz. Foss., p. 40.

² *Ibid.*, p. 40, pl. i B, fig. 6.

³ *Ibid.*, p. 41, pl. i B, fig. 25.

⁴ Palæoz. Foss. p. 7, pl. ii, fig. 7 c.

the visceral chambers are occupied by large oblique vesicles. Height of the corallum $1\frac{1}{2}$ or 2 inches; diameter of the calice often 3 inches or more; depth almost 1 inch.

Wenlock Edge, Benthall Edge, Dormington Wood, Wren's Nest near Dudley. Gothland.

Specimens are in the Collections of the Geological Society of London, of the Museum of Practical Geology, of the Bristol Museum, of Mr. Fletcher, Mr. John Gray, of M. Bouchard-Chantreaux, of MM. de Verneuil, D'Archiac, &c.

This species is easily distinguished from *O. subturbinata*¹ and *O. Murchisoni*,² by its short, cyathoidal form. It much resembles *O. grandis*,³ in which, however, the calicular margin is more lamellated, the septal fossulæ less developed, and the interseptal spaces filled with vesicles that are apparent exteriorly as well as in the interior of the corallum.

The fossil of the Silurian formation of Ireland, which Professor M'Coy⁴ refers to the *Cyathophyllum turbinatum*, Goldfuss, probably belongs to this species. It is found in various localities of the counties of Galway, Kildare, Mayo, and Dublin.

2. OMPHYMA SUBTURBINATA. Tab. LXVIII, figs. 1, 1a, 1b, 1c.

MADREPORA SIMPLEX, TURBINATA, &c. (pars), *Fougt*, Amæn. Acad., vol. i, tab. iv, fig. 3
(Cæt. excl.), 1749.

— TURBINATA (pars), *Esper*, Pflanz. (Petref.), tab. ii, fig. 4; tab. iii, fig. 5.

TURBINATED MADREPORITE, *Parkinson*, Org. Remains, vol. ii, pl. iv, fig. 1, and perhaps also fig. 3, 1808.

TURBINOLIA VERRUCOSA and ECHINATA, *Hisinger*, Anteckningar, vol. v, p. 128, pl. viii, figs. 5 and 6, 1831.

— TURBINATA, var. VERRUCOSA and ECHINATA, *Hisinger*, Leth. Suec., p. 100, tab. xxviii, figs. 7 & 8, 1837.

CYATHOPHYLLUM TURBINATUM, *Lonsdale*, in Murchison, Silur. Syst., p. 690, pl. xvi, figs. 11, 11a, 1839.

— — *Eichwald*, Sil. Syst. in Esthland, p. 200, 1840.

— SUBTURBINATUM, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 47, 1850.

CANINIA TURBINATA, *M'Coy*, Brit. Palæoz. Foss., p. 28, 1851.

OMPHYMA SUBTURBINATA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 401, 1851.

Corallum tall, straight, or slightly bent at its basis, cylindro-turbinate, with a slender peduncle, and presenting round its under half large radiciform appendices. Accretion ridges of the wall in general well developed; epitheca very thin. Calice circular, not very deep; its edge rather thick and not lamellated. Central smooth space of the upper tabula small: septal fossulæ smaller, and not as deep as in *O. turbinata*: septa (80) delicate, and somewhat unequal alternately. A vertical section shows that the tabulæ are very large,

¹ See tab. lxviii, fig. 1.

² See tab. lxvii, fig. 3.

³ *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 403, 1851.

⁴ Syn. of Sil. Foss. of Ireland, p. 61, 1846.

very numerous, strong, horizontal towards the centre, and directed upwards towards the circumference. The vesicles that occupy the exterior part of the visceral chamber are large, oblique, and very unequal in size. These corals become sometimes very large; some specimens are about 7 or 8 inches high.

Wenlock Edge, Walsall, Benthall Edge, Gleedon's Hill, Dudley. Lincoln Hill, Kinsham near Aymestry, Ledbury, Malvern, the Valley of Woolhope, and Prolimoor Well (Sir R. Murchison). Mathyrafal, south of Meifod, Montgomeryshire; Craig Head, Ayrshire (M'Coy).

It is also found in Gothland and in Russia.

Specimens are in the Collections of the Geological Society of London, of the Museum of Practical Geology, of the Bristol Museum, of the Parisian Museum, of Mr. Bowerbank, M. Bouchard-Chantereaux, M. de Verneuil, M. D'Archiac, and M. Michelin.

This species, which till of late was confounded with the preceding one, differs from it by its general form, the proportions of the smooth and radiated parts of the calice, the number of septa, and many other characters.

3. *OMPHYMA MURCHISONI*. Tab. LXVII, figs. 3, 3*a*, 3*b*.

CYSTIPHYLLUM SILURIENSE (pars), *Lonsdale*, in Murchison, Silur. Syst., p. 691, pl. xvi bis, fig. 2 (*Cæt. excl.*), 1839.

OMPHYMA MURCHISONI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 402, 1851.

Corallum turbinate, tall, slightly bent near its basis, and bearing radiciform appendices very high up but in very small number. Accretion ridges of the wall in general strongly characterised. Calice circular, not very deep; the smooth central part of which is pretty well developed. Septal fossulæ very distinct, but not large. Septa (about 60 in number) not closely set, slightly flexuous, and intermingled with some large, very apparent vesicles. A vertical section shows that the tabulæ are large, thick, and generally more or less obliquely placed. The vesicles occupying the outer part of the visceral chamber are very large, unequal in size, and very oblique. Height about 2 inches.

The only specimens that we have seen were found at Wenlock, and belong to the Collection of Mr. Bowerbank.

This coral much resembles *O. subturbinata*¹ by its general form, but differs from it by the small development of its septa, and the existence of very apparent vesicles on the surface of the calice; circumstances that induced Mr. Lonsdale to place it in the genus *Cystiphyllum*.

¹ See tab. lxviii, fig. 1.

4. *Genus* GONIOPHYLLUM (p. lxix).

1. GONIOPHYLLUM FLETCHERI. Tab. LXVIII, figs. 3, 3a.

GONIOPHYLLUM FLETCHERI, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 405, 1851.

Corallum simple, tall, almost straight, pyramidal, and quadrangular. Epitheca presenting strong accretion folds. Calice almost square, rather deep, and appearing to contain about 50 septa. The septal fossulæ are not distinct in the only specimen that we have seen. Height about 1 inch.

Dudley. Collection of Mr. Fletcher.

2. GONIOPHYLLUM PYRAMIDALE.

FUNGITE TETRAGONI, GOTHLANDICI, &c., *Magnus Bromel*, Acta Liter. Suec., vol. ii, p. 446, figs. a, b, 1728.

TURBINOLIA PYRAMIDALIS, *Hisinger*, Anteckningar, vol. v, p. 128, tab. vii, fig. 5, 1831.

— — *Hisinger*, Leth. Suec., p. 101, tab. xxviii, fig. 12, 1837.

CALCEOLA PYRAMIDALIS, *Girard*, Jahrbuch für Miner. und Geol., p. 232, figs. a, b, c, 1842.

PETRAIA QUADRATA, *M'Coy*, Syn. of the Sil. Foss. of Irel., p. 61, pl. iv, fig. 18, 1846.

GONIOPHYLLUM PYRAMIDALE, *Milne Edwards and Jules Haime* (Introd., p. lxix, 1850), Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 404, pl. ii, figs. 4, 4a, 1851.

We refer to this species an apparently ill-preserved specimen found by Professor M'Coy in the Silurian deposits of Ireland, and placed by that palæontologist in the non-characterised genus *Petraia*.

In well-preserved specimens, such as those that are found in Gothland, and have been figured by *Hisinger*, and described by us in a former work, the following characters are seen: *Corallum* simple, pyramidal, slightly curved, with a very narrow peduncle; rather thick epitheca and accretion ridges that sometimes constitute at the angles irregular tubercles, and even thus assume the appearance of short radiceform appendices. Calice almost square, not very deep. Septal fossulæ pretty well characterised, and corresponding to the angles of the visceral chamber. Septa (72) rather thick, but very slightly prominent, and extending almost to the centre of the calice, where they are slightly flexuous. Height about 1 inch.

Ardaun and Kilbride, Cong, in the county of Galway (M'Coy). Gothland.

*G. Fletcheri*¹ differs from this species by its narrow elongated form, and by its septa being less numerous, and by several other characters.

¹ See tab. lxviii, fig. 3.

5. *Genus* CHONOPHYLLUM (p. lxix).

CHONOPHYLLUM PERFOLIATUM? Tab. LXVIII, figs. 2, 2a. (See p. 235, and Tab. IV, fig. 5.)

It is not without some hesitation that we refer to this species, already described in the preceding chapter as being common in the Devonian formation, a coral found by M. D'Archiac in the Silurian rocks at Wenlock. The only apparent difference between this fossil and the Torquay specimen consists in the form of the calice, the border of which is not everted.

6. *Genus* PTYCHOPHYLLUM (p. lxix).

PTYCHOPHYLLUM PATELLATUM. Tab. LXVII. figs. 4, 4a.

FUNGITES MEDLÆ, &c., *Magnus Bromel*, Acta Liter. Suec., vol. ii, p. 463, 1728.

— PATELLATUS, *Schlotheim*, Petref., 1st part, p. 247, 1820.

— — *Kruger*, Gesch. der Urwelt, vol. ii, p. 253, 1823.

— — *Hisinger*, Leth. Suec., p. 99, pl. xxviii, fig. 3, 1837.

STROMBODES PLICATUM, *Lonsdale*, in Murchison, Sil. Syst., p. 691, pl. xvi bis, fig. 4, 1839.

— PLICATUS, *M'Coy*, Sil. Foss. of Ireland, p. 61, 1846.

CYATHOPHYLLUM PATELLATUM, *Bronn*, Index Pal., vol. i, p. 369, 1848.

CYATHAXONIA PLICATA, *D'Orbigny*, Prodr. de Pal., vol. i, p. 48, 1850.

PTYCHOPHYLLUM PATELLATUM, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 407, 1851.

Corallum simple, pedicellated, straight or slightly curved, and short. *Epitheca* wrinkled; borders of the *calice* lamellated and very much everted, so as to give to the corallum the form of a mushroom, and to produce a circular elevation around the central fossula, which is very deep. Pseudo-columella small. *Septa* nearly 100 in number, somewhat unequally developed alternately, rather thick exteriorly, but very slender towards the centre of the calice, where the large ones become strongly twisted, and rise up a little to form the columella. Height about 1½ inch; diameter of the calice twice the height or even more.

Brand Lodge, Malvern, Malvern Mountains. Doonquin and Dingle, in the county of Kerry (M'Coy). It is also met with in Gothland.

Specimens are in the Bristol Museum, Bonn Museum, in the Collections of the Geological Society of London, and of M. de Verneuil.

This species much resembles *P. extensum*¹ in its general form, but its septa are more numerous and more equally developed. It differs from *P. Stokesi*,² by the lesser size of its pseudo-columella.

¹ Milne Edwards and Jules Haime, Pol. Foss. des Terr. Palæoz., p. 408, pl. viii, fig. 2.

² Ibid., p. 407; Stokes, Geol. Trans., 2d ser., vol. i, pl. xxix, fig. 1 (*dextra*), 1824.

7. *Genus ACERVULARIA* (p. lxx).

ACERVULARIA LUXURIANS. Tab. LXIX, figs. 2, 2a, 2b, 2c, 2d, 2e, 2f.

MADREPORA COMPOSITA, &c., *Fougt*, Amæn. Acad., vol. i, p. 93, tab. iv, fig. 8, 1749.

FUNGITES, *Thomas Pennant*, Phil. Trans., vol. xlix, 2d part, p. 515, tab. xv, fig. 11, 1757.

MADREPORA ANANAS (pars), *Linné*, Syst. Nat., edit. 12, p. 1275, 1767.

— TRUNCATA, *Parkinson*, Org. Rem., vol. ii, pl. v, fig. 2, 1808. (Not Linné.)

— ANANAS, *Parkinson*, Ibid., pl. v, fig. 1. (Not Linné.)

FLOSCULARIA LUXURIANS, *Eichwald*, Zool. Spec., vol. i, p. 188, tab. xi, fig. 5, 1829.

ASTREA ANANAS, *Hisinger*, Leth. Suec., p. 98, pl. xxviii, fig. 1, 1837.

CARYOPHYLLIA TRUNCATA, *Hisinger*, Ibid., p. 101, pl. xxviii, fig. 14.

CYATHOPHYLLUM DIANTHUS (pars), *Lonsdale*, in Murchison, Sil. Syst., p. 690, pl. xvi, figs. 12a, 12d, 1839. (Not Goldfuss.)

ASTREA ANANAS, *Lonsdale*, Ibid., p. 688, pl. xvi, fig. 6. (Not Lamarck.)

LITHOSTROTION LONSDALEI, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 48, 1850.

ACERVULARIA ANANAS, *M'Coy*, Brit. Palæoz. Foss., p. 35, 1851.

— LUXURIANS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 415, 1851.

Corallum composite, massive, convex; in general tall. Corallites sometimes free laterally and cylindrical, but in general united by their walls, and compressed so as to become prismatical. In some cases the individuals so united diminish in diameter as they grow up, and so become again free and cylindrical. Epithea thick in the aggregate as well as in the free corallites, and forming on the surface of the massive corallum delicate, zigzag, slightly prominent, polygonal lines, that separate the individuals from each other. Gemmation principally calicinal. *Calices* vary much in size, and are rather deep in the centre. *Septa* nearly equally thick exteriorly, but unequally developed inside of the interior wall, the large ones only extending to the centre; in general 54 in large corallites, and about 30 in the small ones. The area comprised between the two walls terminated by a flat or slightly concave surface. Breadth of the large polygonal individuals about 6 lines; the small ones about 2 lines. Diameter of the true calice or central fossula about half the diameter of the corallites in large specimens, but much more proportionally in the small individuals, where the space comprised between the two mural investments is but little developed.

Dudley, Wenlock. Ledbury, Herefordshire (M'Coy). It is also met with in Gothland and Dalecarlia.

Specimens are in the Collections of the Bristol Museum, Parisian Museum, of the Museum of Practical Geology, of Mr. Fletcher, Mr. John Gray, Mr. Bowerbank, M. Bouchard-Chantreaux, and M. de Verneuil.

This coral may be easily distinguished from the other species of the same genus by the development of its inner walls, and its mode of gemmation, which is almost entirely calicinal.

8. *Genus STROMBODES* (p. lxx).1. *STROMBODES TYPUS*. Tab. LXXI. figs. 1, 1a, 1b.

ARACHNOPHYLLUM TYPUS, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 278, 1850.

— — *M'Coy*, Brit. Palæoz. Foss., p. 38, pl. i B, fig. 27, 1851.

STROMBODES LABECHII, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 427, 1851.

Corallum composite, massive, subturbinate; its upper surface slightly convex; its basal common plate covered with a very thin epitheca, and presenting very prominent and irregular accretion ridges. The terminal surface of the corallites irregularly polygonal, and separated from each other by strong ridges that are more prominent at their angles than elsewhere. Near the centre of these polygonal spaces a slight circular elevation, corresponding to the upper edge of the inner wall, and circumscribing the true calice. Septal radii not distinct from the costæ, and thus extending to the outer edge of the corallite. The total number of the *septo-costal radii* amounts to about 100, but one third of them only extend to the calicinal fossula, where they become curved and somewhat prominent; most of them appear to bear small paliform lobules. The marginal or costal radii are still slenderer than the preceding ones, and adhere to them at their inner edge. Very slender, closely set, unequally distinct dissepiments unite all these radii, so as to constitute delicate very regular quadrangular reticulations. Vertical and horizontal sections show that the structure of the corallum is essentially vesicular. In a section corresponding to the direction of the axis of the corallites, the different layers of that vesicular tissue being of different degrees of density, constitute undulated parallel horizontal lines, the direction of which correspond to that of the surface of the corallum. A horizontal section shows that the inner or true walls are circular and well constituted, and that the reticulations become larger and more regular towards the circumference of the corallites. In many parts no remains of the costæ septal radii are distinct, and the space comprised between the inner wall and the lateral surface of the corallites is completely cellular. Large diagonal of the corallites at the upper surface of the compound mass about 8 lines; diameter of the true calice about 3 lines.

Wenlock Edge. Aymestry, Herefordshire (*M'Coy*).

Specimens are in the Collections of the Paris Museum, Bristol Museum, of the Museum of Practical Geology, and M. de Verneuil.

2. *STROMBODES MURCHISONI*. Tab. LXX, figs. 1, 1a, 1b, 1c, 1d.

ACERVULARIA BALTICA (pars), *Lonsdale*, in *Murchison*, Sil. Syst., p. 689, pl. xvi, figs. 8b, 8c, 8d, 8e (*Cæt. excl.*), 1839. (Not *Schweigger*.)

ACTINOCYATHUS BALTICUS, *D'Orbigny*, Prodr. de Paléont, vol. i, p. 48, 1850.

STROMBODES MURCHISONI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 428, 1851.

Corallum massive, subturbinate; common basal plate covered with a very thick

epitheca, and presenting very irregular accretion wrinkles. Upper surface slightly convex, and presenting large polygonal prominent reticulations formed by the line of junction of the corallites. Circular calicular protuberance small, but pretty distinct. Pseudo-columella somewhat elevated. Septo-costal radii extremely slender and numerous (about 100), but very unequally developed; about 50 of them reach almost to the centre, and about half of these appear to bear a rudimentary paliform lobule. Diagonal about 1 inch; diameter of the calicinal ring about 3 lines. A vertical section shows that the tissue is almost entirely vesicular, and it is only in the parts corresponding to the axis of the visceral chamber that some appearance of vertical striæ corresponding to the septa are visible. The transversal undulating lines that are strongly marked in this section are produced by the intermittent mode of growth of the corallum, and correspond to the different surfaces, which become rather dense after each period of activity. They are almost horizontal in the parts corresponding to the visceral chambers, and suddenly rise up in the parts corresponding to the line of demarcation between the adjoining corallites.

Dudley, Wenlock; Egool and Bellaghaderreen, Mayo (M'Coy).

Specimens in the Collections of the Geological Society, of the Bristol Museum, of Mr. Bowerbank, and of the Parisian Museum.

This species is very closely allied to *S. typus*,¹ but differs from it by its internal structure being more completely vesicular, and by its septa being more closely set.

3. STROMBODES PHILLIPSI. Tab. LXX, figs. 2, 2a.

ACERVULARIA BALTICA, *Phillips*, *Palæoz. Foss. of Cornw., Devon, &c.*, p. 13, pl. vii, fig. 18 E, 1841.

ACTINOCYATHUS PHILLIPSII, *D'Orbigny*, *Prodr. de Paléont.*, vol. i, p. 108, 1850.

STROMBODES PHILLIPSI, *Milne Edwards and Jules Haime*, *Pol. Foss. des Terr. Palæoz.* (*Arch. du Mus.*, vol. v), p. 429, 1851.

Corallum much resembling the preceding ones, but differing from them by the existence of well-characterised paliform lobes. The circular elevation corresponding to the limits of the true calice, is also much larger in proportion to the breadth of the corallite, and the septa are less numerous.

Wenlock. Collection of Professor Phillips.

4. STROMBODES DIFFLUENS. Tab. LXXI, figs. 2, 2a.

ACERVULARIA BALTICA (pars), *Lonsdale*, in *Murchison*, *Silur. Syst.*, pl. xvi, figs. 8, 8a, 1839.

STROMBODES DIFFLUENS, *Milne Edwards and Jules Haime*, *Pol. Foss. des Terr. Palæoz.* (*Arch. du Mus.*, vol. v), p. 431, 1851.

¹ See tab. lxxi, fig. 1.

Corallum massive, subgibbose; epitheca thin. Calicinal circles small, and circumscribing a shallow, but well marked central fossula. Costo-septal radii very delicate, closely set, very flexuous, unequally developed alternately, extending to a considerable distance, and confluent with those of the adjoining individuals. Some appearance of a pseudo-columella produced by the inner extremity of the large septa; some of which are slightly curved. 35 or 40 of these occupy the calicinal space, but exteriorly the number of the septo-costal ridges augments greatly, and varies much. Diameter of the calicinal circles $2\frac{1}{2}$ or 3 lines; depth of the calicinal fossula about half a line. A vertical section shows that the vesicular tissue is rather dense, the cells somewhat unequal in size, and presenting vertical septo-costal striæ, in general distinct, although small.

Much Wenlock.

Specimens are in the Collections of the Museum of Practical Geology, of the Parisian Museum, of Mr. Bowerbank, and M. de Verneuil.

This coral differs from all the other species of the genus *Strombodes* in not having any trace of exterior walls between the individuals.

9. Genus SYRINGOPHYLLUM (p. lxxii).

SYRINGOPHYLLUM ORGANUM. Tab. LXXI, figs. 3, 3a, 3b.

MADREPORA COMPOSITA, &c., *Fougé*, Amæn. Acad., vol. i, p. 96, tab. iv, fig. 6, and No. 1, 1749.

— ORGANUM, *Linné*, Syst. Nat., edit. 12, p. 1278, 1767.

SARCINULA ORGANON, *Schweigger*, Handb. der Naturg., p. 420, 1820.

— ORGANUM, *Goldfuss*, Petref. Germ., vol. i, p. 73, tab. xxiv, fig. 10, 1826. (Not Lamarck.)

— ORGANON, *Eichwald*, Zool. Spec., vol. i, p. 189, 1829.

— ORGANUM, *Holl*, Handb. der Petref., p. 401, 1830.

— — *De Blainville*, Dic. Sc. Nat., vol. lx, p. 314, 1830.—Man., p. 348.

— — *Morren*, Descr. Cor. Belg., p. 67, 1832.

— — *Hisinger*, Leth. Suec., p. 97, tab. xxviii, fig. 8, 1837.

— — *Eichwald*, Sil. Syst. in Esthland, p. 199, 1840.

ASTREOPORA ORGANUM, *D'Orbigny*, Prodr. de Paléont., vol. i, p. 50, 1850.

SARCINULA ORGANUM, *M'Coy*, Brit. Palæoz. Foss., p. 37, 1851.

SYRINGOPHYLLUM ORGANUM, *Milne Edwards* and *Jules Haime* (Introd., p. lxii, 1850), Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. 5), p. 490, 1851.

Corallum massive, astreiform, rather tall; gemmation lateral; calices of unequal size, circular, rather prominent, and placed at a distance from each other about equal to their diameter; costæ thin, but slightly prominent, equally developed, separated by large furrows, straight or slightly flexuous, and extending to the bottom of the inter calicular space, where

they join those of the surrounding corallites. Calicular fossula rather shallow; in all the specimens we have seen it was much clogged up with extraneous matter, but there was still some appearance of a styliform, slightly compressed columella, and of a crucial mode of arrangement of the principal septa. Septa (24 or 26,) well developed, rather thick, of unequal size alternately, and slightly exsert. Diameter of the calice about 1 line.

The British specimens examined by us were found in the upper Silurian rocks at Dudley, and in the inferior Silurian deposits at Coniston. Professor M'Coy mentions its existence at Coniston Water Head, Lancashire; Sunny Brow near Coniston; High Haume, Dalton in Furness, Lancashire; Long Steddale, Westmoreland; Appleshwaite Common, Westmoreland. It is also found in Gothland, in Groningue, and in Russia.

Specimens are in the Collections of the Paris Museum, Bristol Museum, of the Geological Society of London, and M. de Verneuil.

Professor M'Coy thinks that the name of *Sarcinula* ought to be applied to this genus, because Lamarck considered the recent coral for which he established it as being identical with the *Madrepora Organum* of Linné; but we cannot adopt his opinion. For when Lamarck formed his genus *Sarcinula* he had evidently in view the above-mentioned recent coral, to which alone its characters are applicable, and the blunder he made consists only in the misapplication of the Linnean name. This specimen, which still exists in the public collection of the Parisian Museum, and has been figured in a recent work¹, must therefore receive a new specific name, but its generic name cannot be transferred to a fossil that differs essentially from it, and that Lamarck had never an opportunity of examining.

10. *Genus* LONSDALEIA (p. lxxii²).

LONSDALEIA WENLOCKENSIS.

STROMBODES WENLOCKENSIS, M'Coy, Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 274, 1850.

— — M'Coy, Brit. Palæoz. Foss., p. 34, pl. i B, fig. 28, 1851.

“*Corallum* forming large, irregular masses of polygonal stems, the mouth of which vary usually from 8 to 10 lines in diameter; boundary walls strong, prominent, vertically sulcated on the inside; stars depressed round the margin of the walls, forming a large circular convexity nearer the centre, within which is a concavity from which rises the thick prominent compound axis; radiating lamellæ 24 in small specimens, 30 in large ones, strongest and most prominent in the circular convexity of the star, where an equal number of small alternate ones disappear; a vertical section shows the thick central axis composed of

¹ Milne Edwards, in Règne Anim. de Cuvier, Zooph., pl. 85, fig. 1.

² Under the name of *Lithostrotium*.

irregularly twisted plates; inner area a little narrower than the outer area, from which it is separated by a solid vertical wall, crossed by loose vesicular structure, curving upwards and outwards, one, or rarely two, vesicular plates reaching across the area on each side; vesicular plates of the outer area more curved, slightly smaller, the rows inclining slightly upwards and outwards, scarcely three cells in a row. A star 9 lines in diameter, has the prominent circular portion, 7 lines in diameter, and the prominent axis rather more than 1 line in diameter.

"Not uncommon in the Wenlock limestone near Wenlock, Shropshire." M'Coy, *op. cit.*

Family CYSTIPHYLLIDÆ, (p. lxxii.)

Genus CYSTIPHYLLUM (p. lxxii).

1. CYSTIPHYLLUM CYLINDRICUM. Tab. LXXII, figs. 2, 2a, 2b. 2c.

FUNGITES GOTHLANDICUS, &c., *Magnus Bromel*, Act. Liter. Suec., vol. ii, p. 464, No. 18, 1728.

CYSTIPHYLLUM CYLINDRICUM, *Lonsdale*, in Murchison, Silur. Syst. p. 691, pl. xvi bis, fig. 3, 1839.

— — *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 464, 1851.

Corallum tall, turbinate when young, but becoming cylindrical by growth, and presenting numerous irregular accretion ridges; epitheca strong, and often presenting radicle-form tubercles or appendices, which sometimes accidentally unite several individuals together. *Calice* circular, rather shallow, and entirely covered with large irregular vesicles, but still showing some appearance of septal striæ. A vertical section shows that the vesicles are rather small, and very irregular. Height about 2 inches.

Benthall Edge: Ardaun and Cong, Kerry (M'Coy.)

Specimens are in the Collections of the Geological Society of London and of M. de Verneuil.

2. CYSTIPHYLLUM GRAYI. Tab. LXXII, figs. 3, 3a.

CYSTIPHYLLUM GRAYI, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 465, 1851.

This species is very nearly allied to the preceding one, but the vesicles of the calice

are much smaller and less irregular, and the lateral circular accretion ridges are much less developed. Height about 2 inches, diameter of the calice $1\frac{1}{4}$ inch.

Dudley. Collection of the Geological Society, of Mr. Fletcher, Mr. John Gray, &c.

3. CYSTIPHYLLUM SILURIENSE. Tab. LXXII, figs. 1, 1a.

CYSTIPHYLLUM SILURIENSE (pars), *Lonsdale*, in Murchison, Sil. Syst., p. 691, pl. xv bis, 1839. (Not the fig. 2, which is an Omphyma.)

CYATHOPHYLLUM VESICULOSUM, *Eichwald*, Sil. Syst. in Esthl., p. 201, 1840.

CYSTIPHYLLUM SILURIENSE, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz. (Arch. du Mus., vol. v), p. 465, 1851.

Corallum turbinate, short, and very broad; epitheca thick, and presenting some radicle-form prolongations. *Calice* subcircular, rather deep, very broad, presenting some obscure indications of septal striæ, and occupied by large unequal vesicles, the structure of which is very distinct in a vertical section. Height about $1\frac{1}{2}$ or 2 inches; diameter of the calice somewhat more.

Wenlock. Dudley (Lonsdale); Ardaun and Cong (M'Coy); Russia (Eichwald).

Collection of the Geological Society of London.

The Silurian fossil described by Professor M'Coy, under the name of *Fistulipora decipiens*,¹ much resembles a *Heliolites*, in which all traces of the septal apparatus have disappeared, and the cœenchyma does not present the vesicular structure which is characteristic of the genus *Fistulipora*, but is made up of small vertical tubes, divided like the visceral chambers by numerous horizontal tubulæ.

The same palæontologist has recently added to the list of the British Silurian Corals, two other species, the zoological characters of which are still so imperfectly known, that we cannot give any decided opinion respecting their natural affinities. One of these,

¹ M'Coy, Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 285, 1850; *ibid.*, Brit. Palæoz. Foss., p. 11, pl. i c, fig. 1, 1851.

"*Corallum* forming hemispherical or sub-cylindrical masses, three or four inches in diameter, concentrically wrinkled at base; cell-tubes straight, sub-parallel, with moderately thick walls, leaving clearly definite, circular, smooth-edged cells in the transverse section, very regular in size and disposition; usually slightly less than half a line in diameter, and averaging rather less than their diameter in the shortest line between adjacent cells, in which line there are usually two, or more, rarely three, of the intermediate vesicular cellules; about eighteen of the intermediate or polygonal cellules in the space of two lines; diaphragms in the small tubes slightly more or less than their diameter apart, two inter-diaphragmal spaces in the large tubes slightly exceeding the diameter.

"Wenlock Limestone, near Aymestry, Herefordshire." (M'Coy, *op. cit.*)

Protovirgularia dichotoma,¹ may probably belong to the group of Sertularina, the other, *Pyritonema fasciculus*,² is a cylindrical bundle of small vertical tubes.

¹ Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 272, 1850; Brit. Palæoz. Foss., p. 10, pl. i B, figs. 11 and 12, 1851.

"One specimen, about two and a half inches long, branches twice at an angle of about 30°, and shows all the pinnules extended at right angles to the capillary axis, with a gentle upward curvature, like the living *Virgularia* in the same state; another simple fragment about the same length has them half extended, being nearly straight, and oblique to the axis; a third fragment has them quite contracted, resembling a bit of narrow braid, exactly like the contracted state of the recent *Virgularia mirabilis*. This one shows very plainly the transverse cell-ridging. Width rather less than one line; four pinnæ in the space of two lines.

"In the slate at Rockerby, Dumfriesshire." (M'Coy, loc. cit.)

² Ann. and Mag. of Nat. Hist., 2d ser., vol. vi, p. 273, 1850; Brit. Palæoz. Foss. p. 10, pl. i B, fig. 13.

"I have proposed the above name for a singular fragment of a fossil from the dark limestone of Tre Gil, S. of Llandeilo. It is nearly straight, about two and a half inches long, four lines wide, and one and a half line thick, and marked longitudinally with coarse thread-like ridges, about the third of a line in diameter, occasionally cut by small sharp transverse wrinkles; the whole having some resemblance to an *Ichthyodorulite* (*onchus* or *ctenacanthus*). On first seeing the specimen, I doubted this reference, from observing that the ridges, instead of being merely superficial, thicker, and more numerous at one end, as they should be on this view, seemed equally thick at each end, and clearly not in one plane, but those at the surface of one part plunging into the mass and giving place to others emerging from it. Owing to the skill and kindness of Mr. Anthony, of Caius College, two sections for the microscope were prepared, which proved that the whole mass was really a bundle of thread-like rods of silica, corresponding exactly in diameter with the external ridges, the sections of which exactly correspond with the others in the interior; the siliceous fibres are solid, cylindrical, with slight occasional transverse rugosities; they are less than their own diameter apart, and the interstices shew no organisation under a magnifying power of 300 diameters, the limestone being of a finer texture, and lighter colour than that of the matrix, as if there had been originally a soft animal matter in the spaces between, which kept out the coarse calcareous mud, but the space occupied by which became filled with fine material by percolation on its decomposition." (M'Coy, loc. cit.)

TAB. LVII.

CORALS OF THE SILURIAN FORMATION.

PALÆOCYCLUS PORPITA (p. 246).

- Fig. 1. Upper surface of a specimen found at Dudley; Collection of Mr. Fletcher; natural size.
- 1*a*. Lower surface of another specimen found at Dudley; Collection of Mr. Fletcher; natural size.
- 1*b*. Side view of the specimen figured in 1; natural size.
- 1*c*. Upper surface of the specimen figured in 1; magnified.

PALÆOCYCLUS PRÆACUTUS (p. 247).

- Fig. 1. Upper surface of a specimen found at Marloes Bay, and belonging to the Collection of the Geological Society of London; natural size.
- 2*a*. Lower surface of the same; natural size.
- 2*b*. Side view of the same; natural size.
- 2*c*. A part of the upper surface, magnified.

PALÆOCYCLUS FLETCHERI (p. 248).

- Fig. 3. Side view of a young specimen; natural size.
- 3*a*. Upper surface of the same; natural size.
- 3*b*. Upper surface of an adult specimen; natural size.
- 3*c*. Side view of a young elongate specimen.
- 3*d*. Side view of an adult specimen; natural size.
- 3*e*. A specimen bearing two young ones; natural size.
- 3*f*. Part of the upper surface of 3*b*, magnified.

All these specimens were found at Dudley, and belong to the Collection of Mr. Fletcher.

PALÆOCYCLUS RUGOSUS (p. 248).

- Fig. 4. Side view of a small specimen; natural size.
- 4*a*. Upper surface of another specimen; natural size.
- 4*b*, 4*c*. Side views of two elongate ones; natural size.
- 4*d*. Part of the upper surface of 4*a*, magnified.

These various specimens were found at Dudley, and belong to the Collection of Mr. Fletcher.

HELIOLITES INTERSTINCTA (p. 249).

Fig. 5. A specimen found at Much Wenlock, belonging to the Collection of Mr. J. S. Bowerbank.

5*a*. Portion of the surface ; natural size.

5*b*. Portion of the same surface, magnified.

5*c*. A cast found at Applethwaite, belonging to the Collection of the Geological Society of London.

5*d*. A part of the same surface, magnified.

HELIOLITES MURCHISONI (p. 250).

Fig. 6. Under surface of a specimen found at Wenlock Edge, belonging to the Museum of Paris ; natural size.

6*a*. A part of the upper surface ; natural size.

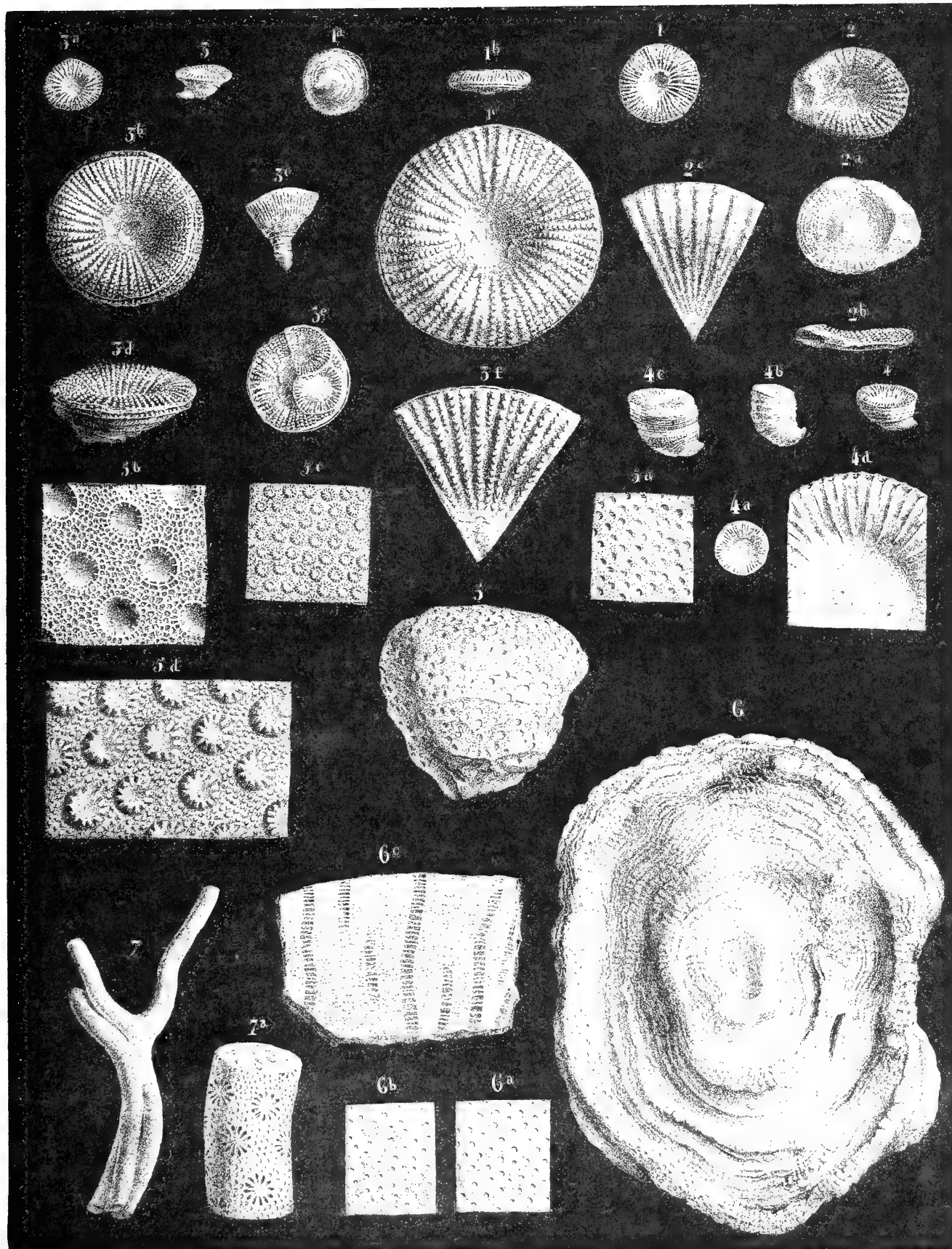
6*b*. A part of the surface of a smaller specimen from Dudley, belonging to M. de Verneuil ; natural size.

6*c*. Vertical section of the specimen figured in 6 ; somewhat magnified.

HELIOLITES INORDINATA (p. 253).

Fig. 7. A specimen from Robeston Walthen ; in the Collection of the Geological Society of London ; natural size.

7*a*. Part of the same, magnified.



TAB. LVIII.

CORALS OF THE SILURIAN FORMATION.

HELIOLITES GRAYI (p. 252).

Fig. 1. A portion of a large specimen found at Walsall, belonging to the Collection of Mr. John Gray ; natural size. (Restored by means of several fragments.)

1*a*. Part of the surface, magnified.

HELIOLITES MEGASTOMA (p. 251).

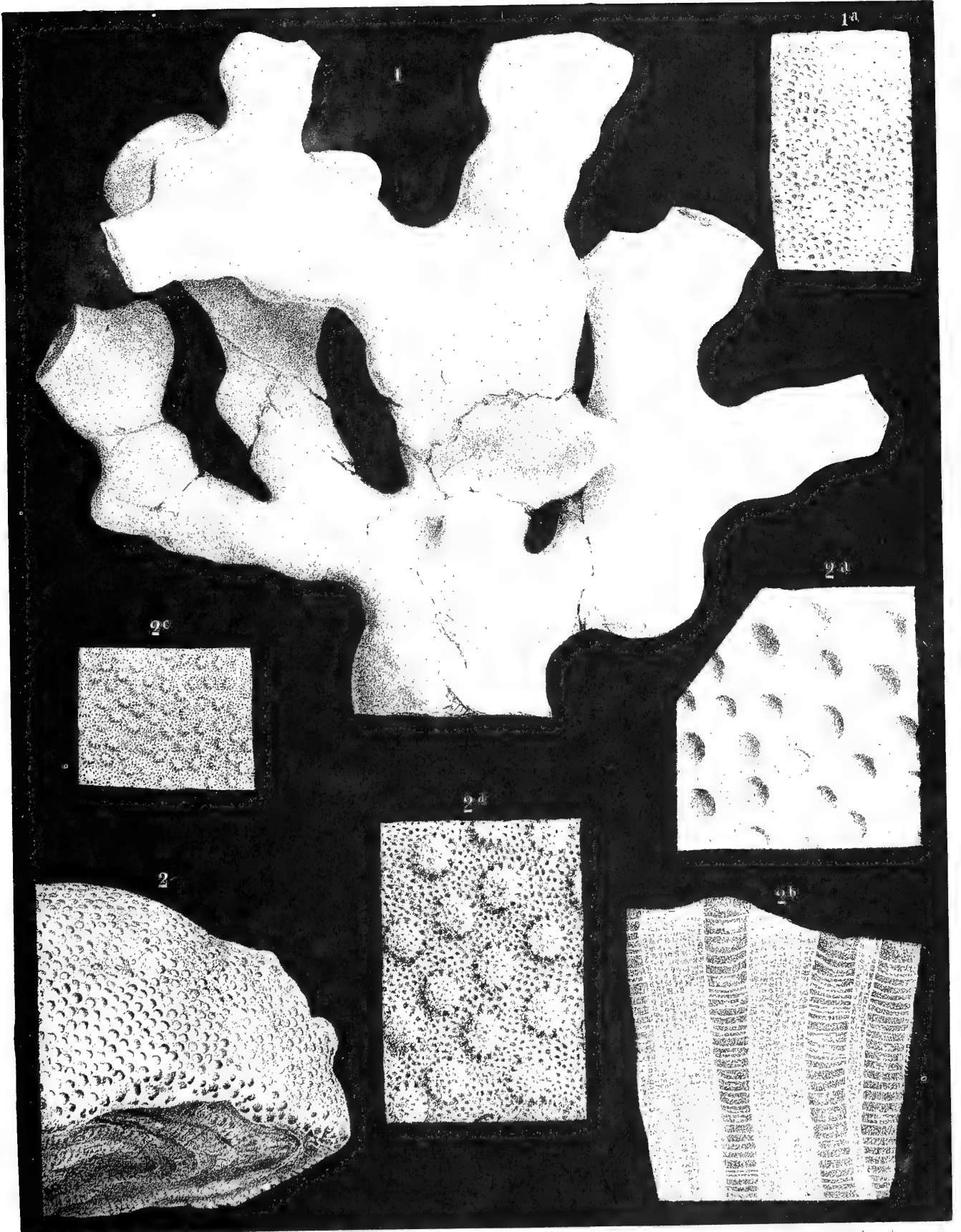
Fig 2. A portion of a specimen found at Wenlock Edge, in the Collection of the Museum of Paris ; natural size.

2*a*. Part of its surface, magnified.

2*b*. Vertical section of the same, magnified.

2*c*. Surface of a cast found at Coniston, in the Collection of the Geological Society of London ; natural size.

2*d*. Part of the same, magnified.



Placorbauer ad nat in lap. del.

TAB. LIX.

CORALS OF THE SILURIAN FORMATION.

PLASMOPORA PETALIFORMIS (p. 253).

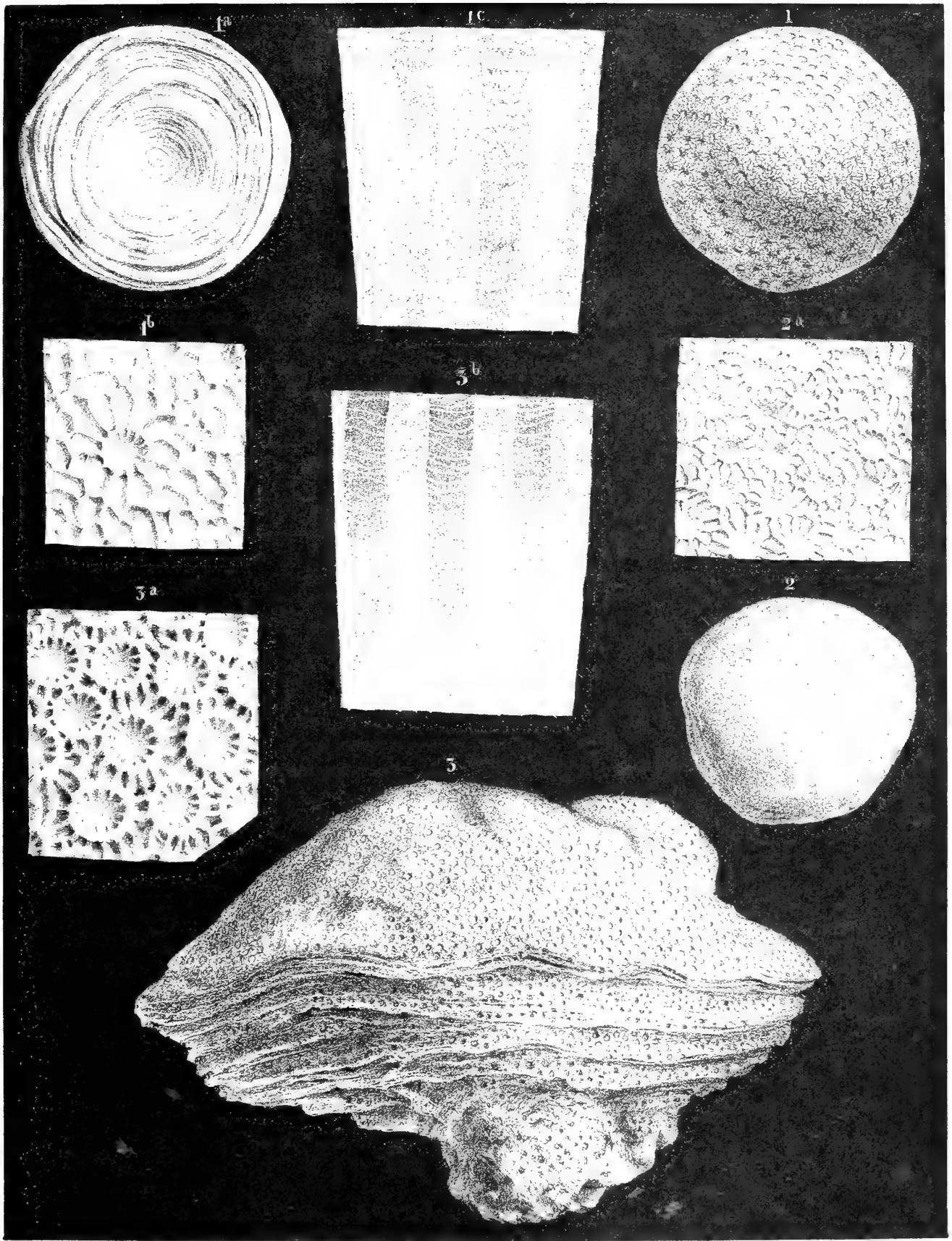
- Fig. 1. Upper surface of a specimen found at Dudley, belonging to the Parisian Museum; natural size.
- 1*a*. Under surface of the same; natural size.
- 1*b*. A magnified portion of the surface of another specimen, found also at Dudley, and belonging to the Collection of Mr. John Gray, in which the calices are more distant, than in the preceding specimen.
- 1*c*. Vertical section of the specimen figured in 1 and 1*a*.

PLASMOPORA SCITA (p. 254).

- Fig. 2. Upper surface of a specimen from Dudley, in the Collection of Mr. John Gray; natural size.
- 2*a*. Calices, magnified.

PROPORA TUBULATA (p. 255).

- Fig. 3. Side view of a specimen from Wenlock, belonging to the Museum of Paris; natural size.
- 3*a*. Calices, magnified.
- 3*b*. Part of a vertical section, magnified.



TAB. LX.

CORALS FROM THE SILURIAN FORMATION.

FAVOSITES GOTHLANDICA (p. 256).

- Fig. 1. Side view of a broken specimen from Dinas court, belonging to the Collection of the Geological Society of London ; natural size.
- 1*a*. A cast from Cullimore's quarry, belonging to the same Collection ; natural size.

FAVOSITES FORBESI (p. 258).

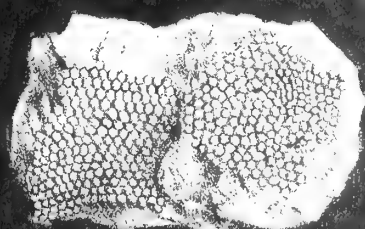
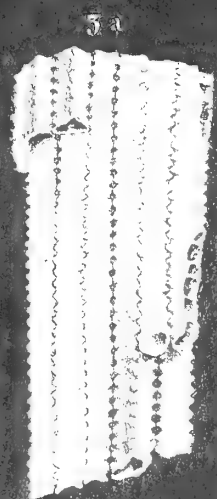
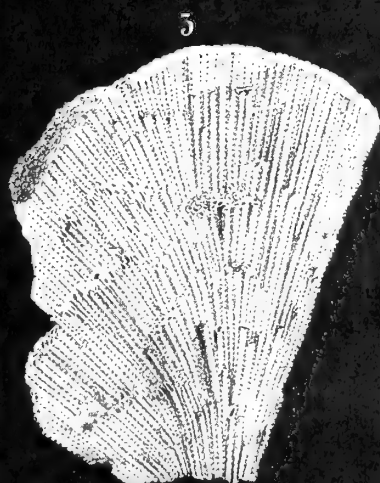
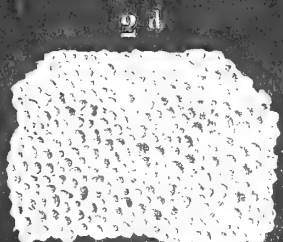
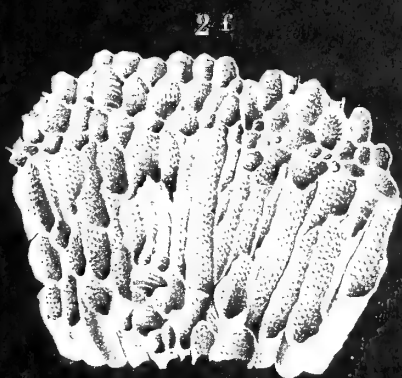
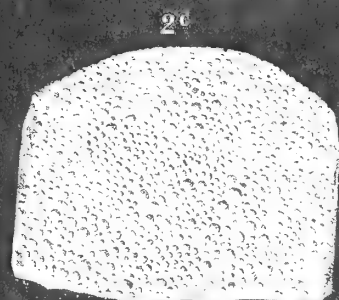
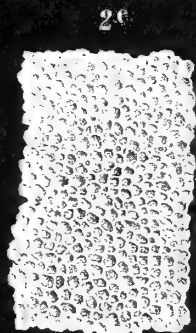
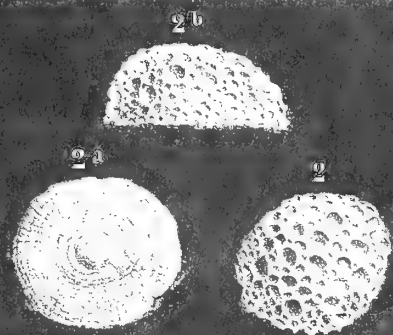
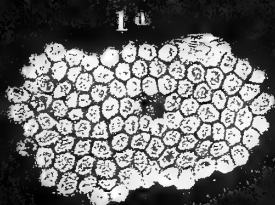
- Fig. 2. Upper surface of a young specimen found at Dudley, belonging to the Collection of Mr. T. W. Fletcher ; natural size.
- 2*a*. and 2*b*. Under surface and side view of other young specimens from the same locality and the same Collection ; natural size.
- 2*c*. Upper surface of a specimen found at Dudley, belonging to the Museum of Paris ; natural size.
- 2*d*. Portion of the surface of another specimen from Wren's Nest, in the Collection of the Geological Society ; natural size.
- 2*e*. Portion of the surface of another specimen from Dudley, belonging to the Museum of Paris ; natural size.
- 2*f*. Some corallites, magnified. Specimen from Wenlock ; Collection of the Geological Society.
- 2*g*. Vertical section of the specimen figured in 2*c* ; amplified.

FAVOSITES ASPERA (p. 257).

- Fig. 3. A broken specimen from Leinthall Earls, near Ludlow, belonging to the Collection of the Geological Society ; natural size.
- 3*a*. Some corallites ; amplified.

FAVOSITES MULTIPORA (p. 258).

- Fig. 4. A cast found at Haverford West, belonging to the Collection of the Geological Society of London ; natural size.



TAB. LXI.

CORALS OF THE SILURIAN FORMATION.

FAVOSITES HISINGERI (p. 259).

- Fig. 1. Side view of a specimen found at Benthall Edge by M. Bouchard-Chantereaux;
natural size.
- 1*a*. Calices, amplified.
- 1*b*. Vertical section, of amplified, a specimen from Wenlock Edge, belonging to
the Museum of Paris.

ALVEOLITES GRAYI (p. 263).

- Fig. 2. A portion of the surface of a specimen from Dudley, belonging to Mr. John
Gray; natural size.
- 2*a*. Calices, magnified.

FAVOSITES CRISTATA (p. 260).

- Fig. 3. A specimen from Dudley, belonging to the Collection of Mr. Bowerbank;
natural size.
- 3*a*. A part of its surface, magnified.

FAVOSITES CRISTATA (*varietas major*, p. 260).

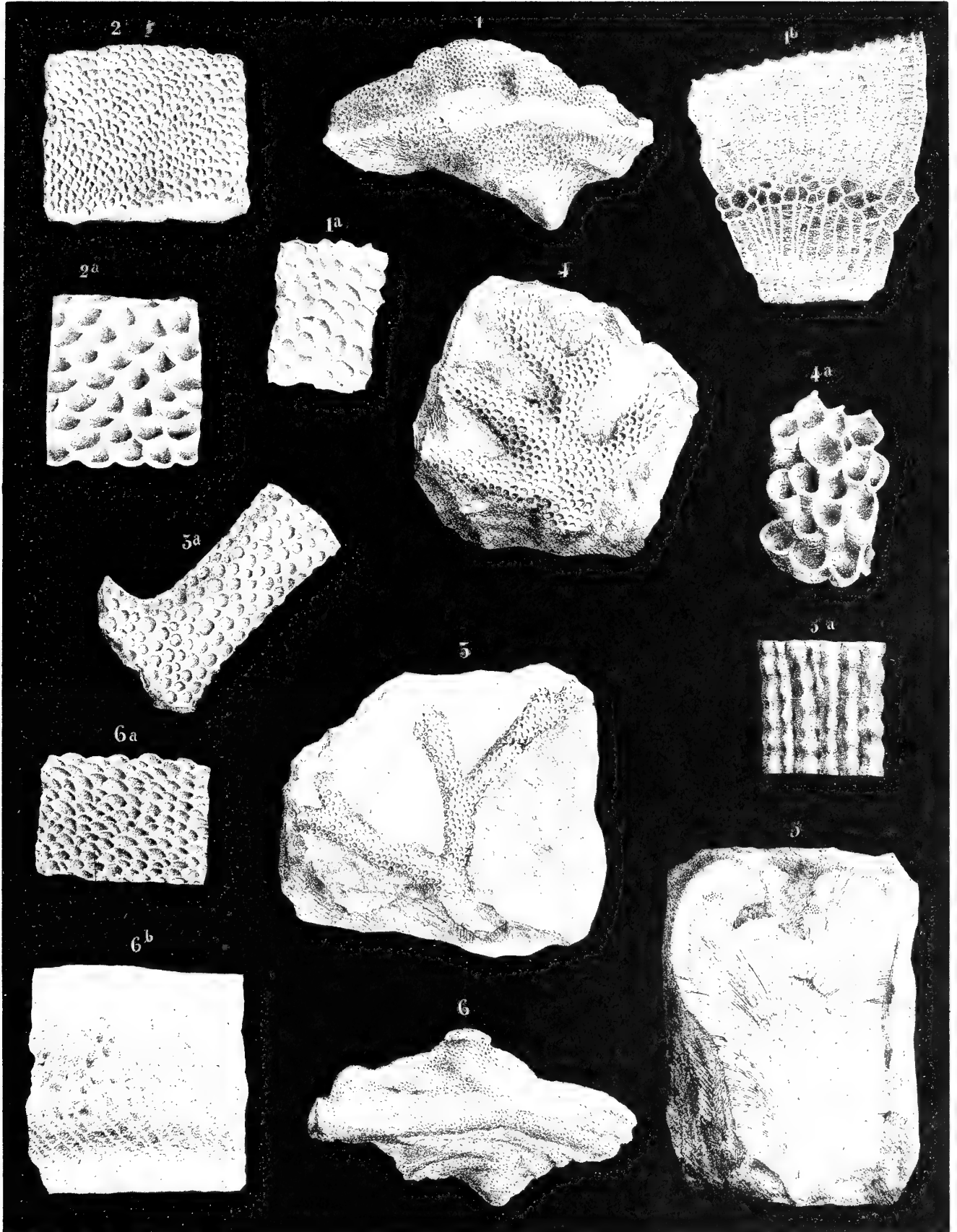
- Fig. 4. A specimen from Wenlock, belonging to the Museum of Paris; natural
size.
- 4*a*. A portion of its surface, magnified.

FAVOSITES FIBROSA (pp. 217, 261).

- Fig. 5. A broken lobate specimen from Horderley, belonging to the Collection of the
Geological Society of London; natural size.
- 5*a*. Corallites, amplified.

ALVEOLITES LABECHEI (p. 262).

- Fig. 6. Side view of a specimen from Wenlock, in the Museum of Paris.
- 6*a*. Calices, magnified.
- 6*b*. A part of a vertical section, magnified.



TAB. LXII.

CORALS OF THE SILURIAN FORMATION.

ALVEOLITES REPENS (p. 263).

- Fig. 1. A specimen from Dudley, belonging to the Collection of Mr. Fletcher;
natural size.
1*a*. Branches, magnified.

ALVEOLITES? SERIATOPOROIDES (p. 263).

- Fig. 2. A specimen from Dudley, belonging to the Collection of Mr. Fletcher;
natural size.
2*a*. A branch, magnified.

MONTICULIPORA FLETCHERI (p. 267).

- Fig. 3. A small specimen found at Dudley, belonging to the Collection of the
Geological Society of London; natural size.
3*a*. Top of a branch, magnified.

MONTICULIPORA PAPILLATA (p. 266).

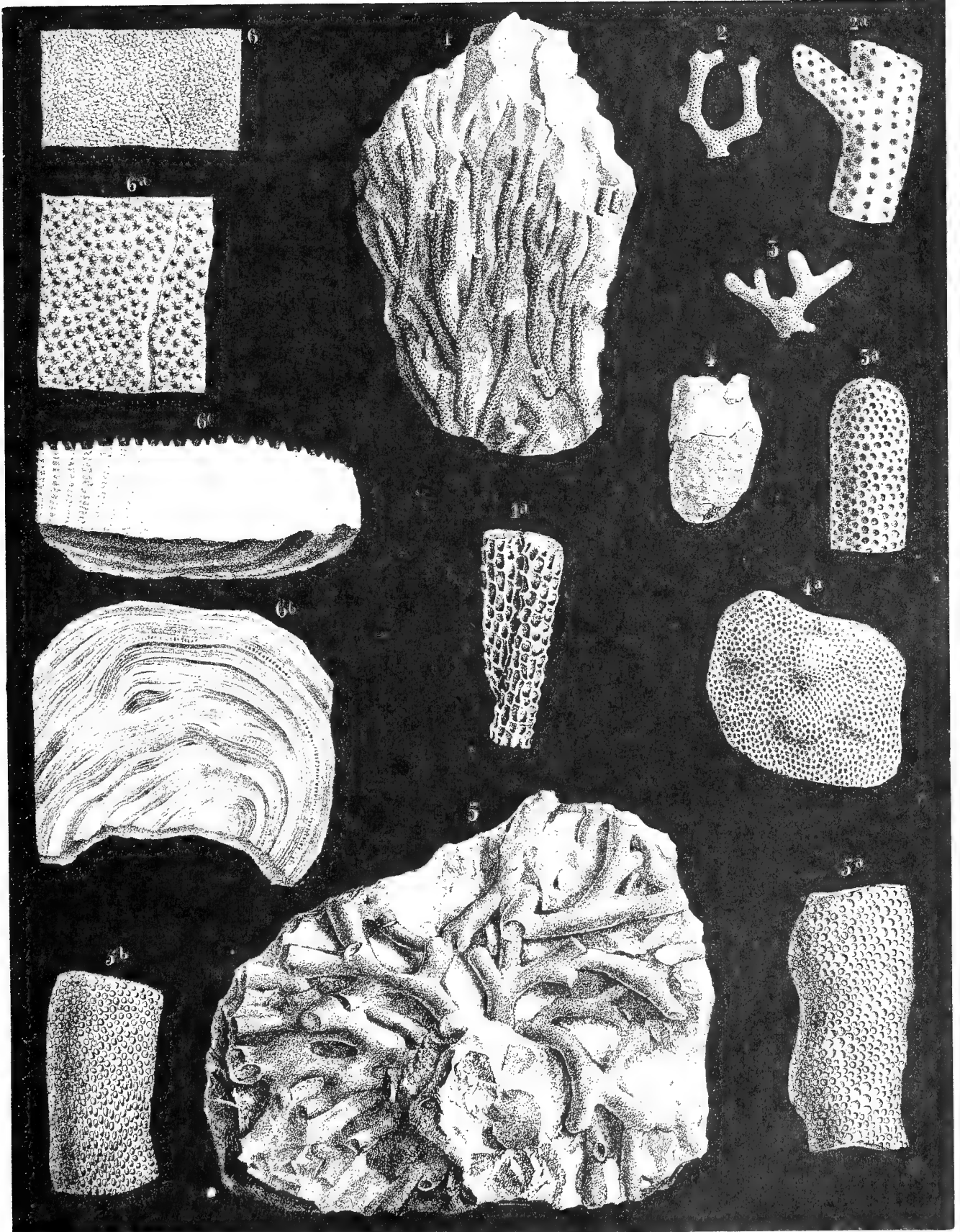
- Fig. 4. A young specimen found at Dudley by Mr. Fletcher; natural size.
4*a*. A portion of its surface, magnified.

MONTICULIPORA PULCHELLA (p. 267).

- Fig. 5. A specimen from Dudley, belonging to the Collection of Mr. Fletcher;
natural size.
5*a* and 5*b*. Two branches, magnified.

LABECHEIA CONFERTA (p. 269).

- Fig. 6. Upper surface of a specimen found by us at Benthall Edge, and placed in the
Museum of Paris.
6*a*. The same surface, magnified.
6*b*. Vertical section, magnified.
6*c*. Under surface of the same specimen; natural size.



TAB. LXIII.

CORALS OF THE SILURIAN FORMATION.

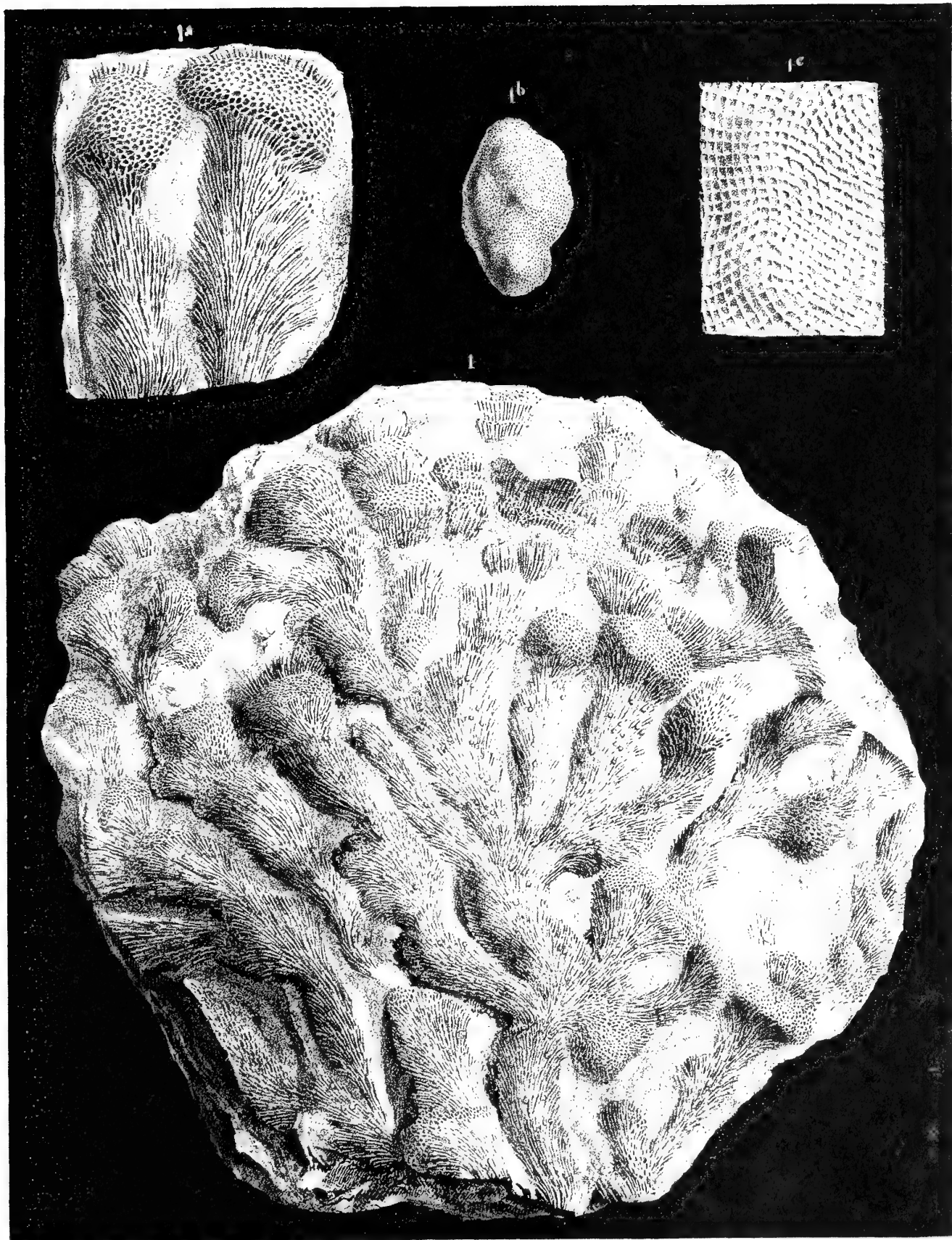
MONTICULIPORA BOWERBANKI (p. 268).

Fig. 1. A large specimen found at Dudley, belonging to the Collection of Mr. Fletcher.

1*a*. A terminal portion, magnified.

1*b*. A young specimen from the same locality and Collection.

1*c*. A portion of its surface, magnified.



TAB. LXIV.

CORALS OF THE SILURIAN FORMATION.

HALYSITES CATENULARIA (p. 270).

Fig. 1. Side view of a vertical series of corallites; natural size. This specimen is from Dudley, and belongs to the Collection of the Geological Society of London.

1*a*. Upper surface of another specimen, from the same locality and Collection; natural size.

1*b*. Vertical section in a specimen from Dudley; natural size. (*Varietas major*.)

1*c*. Upper surface of a specimen found at Benthall Edge by M. Bouchard-Chantereaux; natural size. (*Var. agglomerata*.)

HALYSITES ESCHAROIDES (p. 272).

Fig. 2. Upper surface of a specimen found at Benthall Edge by M. Bouchard-Chantereaux; natural size.

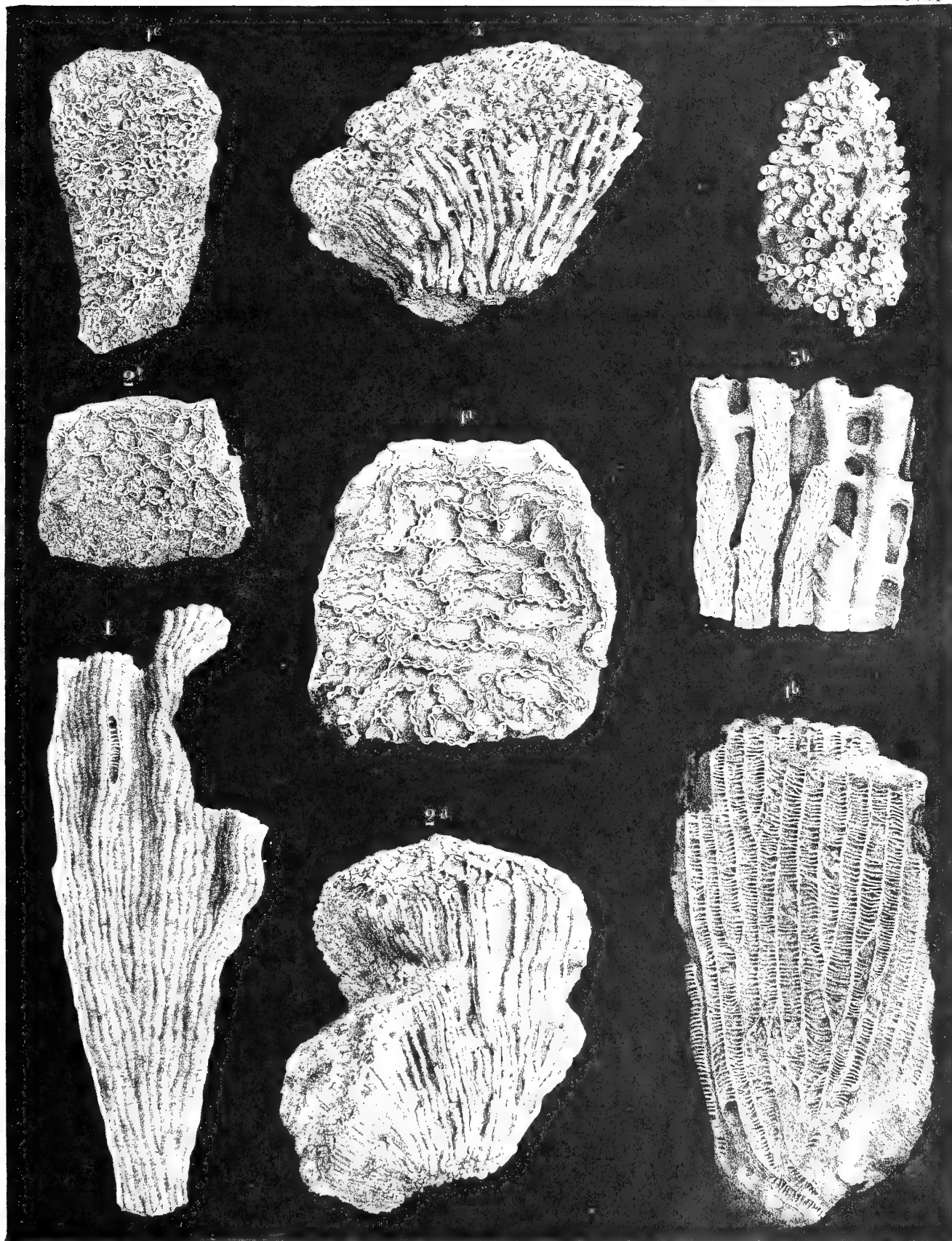
2*a*. Side view of the same specimen.

SYRINGOPORA BIFURCATA (p. 273).

Fig. 3. Side view of a specimen found at Dudley, belonging to the Collection of Mr. Fletcher; natural size.

3*a*. Its upper surface; natural size.

3*b*. Some corallites, magnified.



TAB. LXV.

CORALS OF THE SILURIAN FORMATION.

SYRINGOPORA FASCICULARIS (p. 274).

Fig. 1. Young state of the corallum; natural size; Dudley, Collection of M. de Verneuil.

1*a*. Upper surface of a young mass, embedded in the extraneous matter; natural size; from the same locality and Collection.

1*b*. Upper surface of a specimen, found also at Dudley, belonging to the Collection of Mr. Fletcher; natural size.

1*c*. Under surface of a specimen from Dudley, belonging to M. de Verneuil; natural size.

SYRINGOPORA SERPENS (p. 275).

Fig. 2. Side view of a specimen from Dudley, belonging to the Collection of Mr. Fletcher; natural size.

2*a*. Upper surface of the same, somewhat magnified.

CÆNITES LINEARIS (p. 277).

Fig. 3. A part of a specimen found at Dudley, in the Collection of Mr. Fletcher; magnified.

CÆNITES JUNIPERINUS (p. 276).

Fig. 4. A specimen from Dudley, in the Collection of Mr. Fletcher; natural size.

4*a*. A portion of its surface, magnified.

CÆNITES INTERTEXTUS (p. 276).

Fig. 5. A specimen from Dudley, in the Collection of Mr. Fletcher; natural size.

5*a*. A part of its surface, magnified.

CÆNITES LABROSUS (p. 277).

Fig. 6. A specimen found at Dudley, belonging to the Collection of Mr. Fletcher; natural size.

6*a*. A part of its surface, magnified.

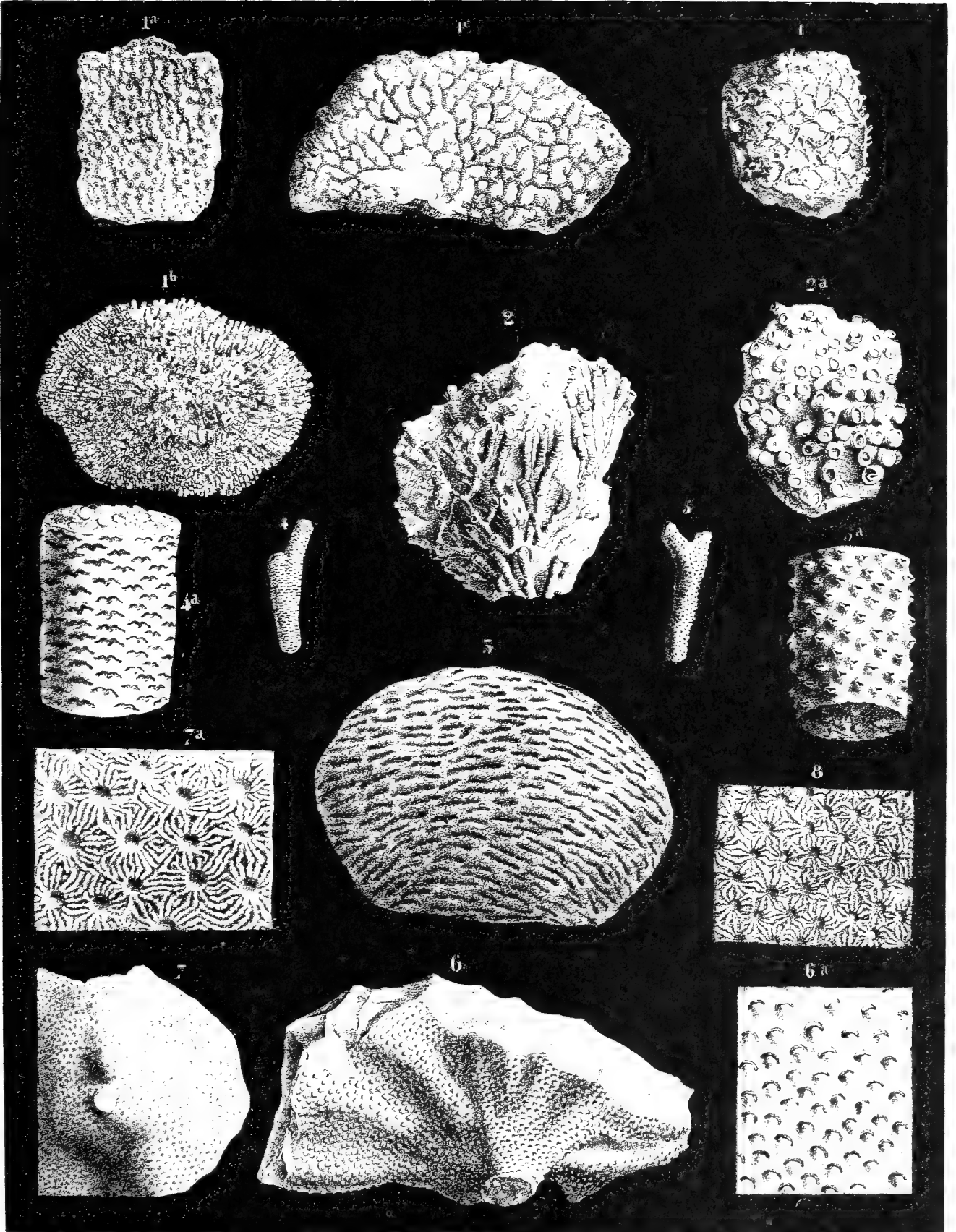
THECIA SWINDERNANA (p. 278).

Fig. 7. Upper surface of a specimen from Lincoln Hill, belonging to M. Bouchard-Chantreaux; natural size.

7*a*. Some calices, amplified.

THECIA GRAYANA (p. 279).

Fig. 8. A part of the upper surface of a specimen from Dudley, belonging to the Collection of Mr. John Gray; magnified.



TAB. LXVI.

CORALS OF THE SILURIAN FORMATION.

AULACOPHYLLUM MITRATUM (p. 280).

Fig. 1. A young specimen, found at Dudley, belonging to the Collection of Mr. John Gray; natural size.

1*a*. An adult specimen from the same locality, belonging to Mr. Fletcher's Collection; natural size.

1*b*. Calice of the specimen figured in 1, magnified.

CYATHOPHYLLUM LOVENI (p. 280).

Fig. 2. Side view of a specimen from Wren Nest, belonging to the Collection of M. Bouchard-Chantereaux; natural size.

2*b*. Calice, magnified.

CYATHOPHYLLUM PSEUDOCERATILES (p. 282).

Fig. 3. A young specimen found at Dudley, belonging to the Collection of Mr. Fletcher; natural size.

3*a*. Calice, magnified.

3*b*. An adult specimen from Wenlock, belonging to the Collection of M. Bouchard-Chantereaux.

CYATHOPHYLLUM AUGUSTUM (p. 281).

Fig. 4. A specimen from Attwood's Shaft, belonging to the Collection of the Geological Society of London; natural size.

4*a*. Vertical section, somewhat magnified.

CYATHOPHYLLUM TRUNCATUM (p. 284).

Fig. 5. A compound corallum found at Dudley, belonging to the Collection of Mr. Fletcher; natural size.

5*a*. Another specimen from the same locality, belonging to the Collection of the Geological Society of London; natural size.

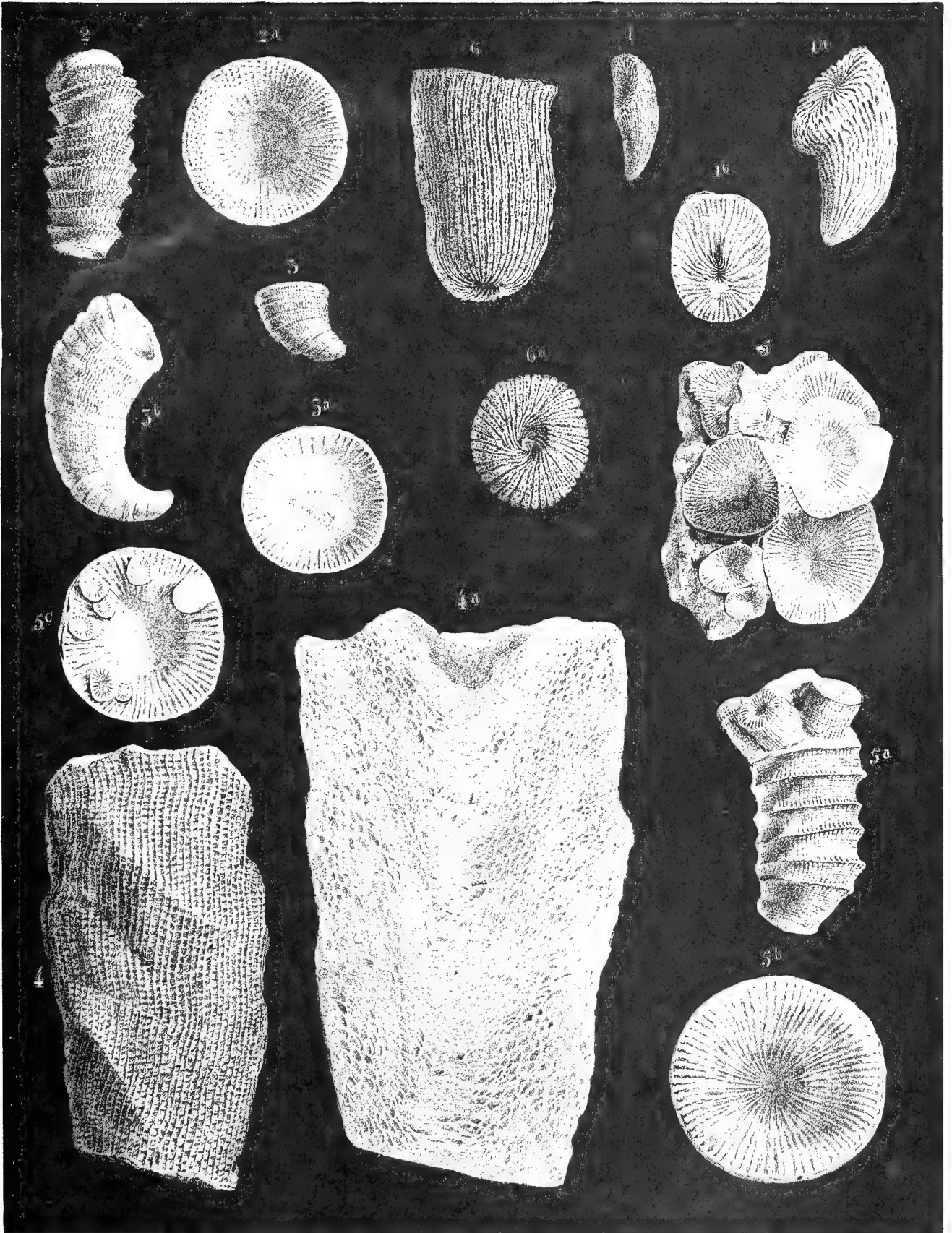
5*b*. A calice, magnified.

5*c*. Another calice, magnified, and bearing some young corallites.

CYATHOPHYLLUM (TURBINOLOPSIS) ELONGATUM (p. 286).

Fig. 6. Side view of a cast found at Leach Heath, belonging to the Collection of the Geological Society; natural size.

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TAB. LXVII.

CORALS OF THE SILURIAN FORMATION.

CYATHOPHYLLUM ARTICULATUM (p. 282).

Fig. 1. A large specimen found at Dudley, belonging to the Collection of Mr. Fletcher; natural size.

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CYATHOPHYLLUM FLEXUOSUM (p. 285).

Fig. 2. A specimen from Much Wenlock, belonging to the Collection of Mr. Bowerbank; natural size.

2*a*. A corallite found at Malvern, in the Collection of the Geological Society of London, magnified.

OMPHYMA MURCHISONI (p. 289).

Fig. 3. Two corallites found at Wenlock, belonging to the Collection of Mr. Bowerbank; natural size.

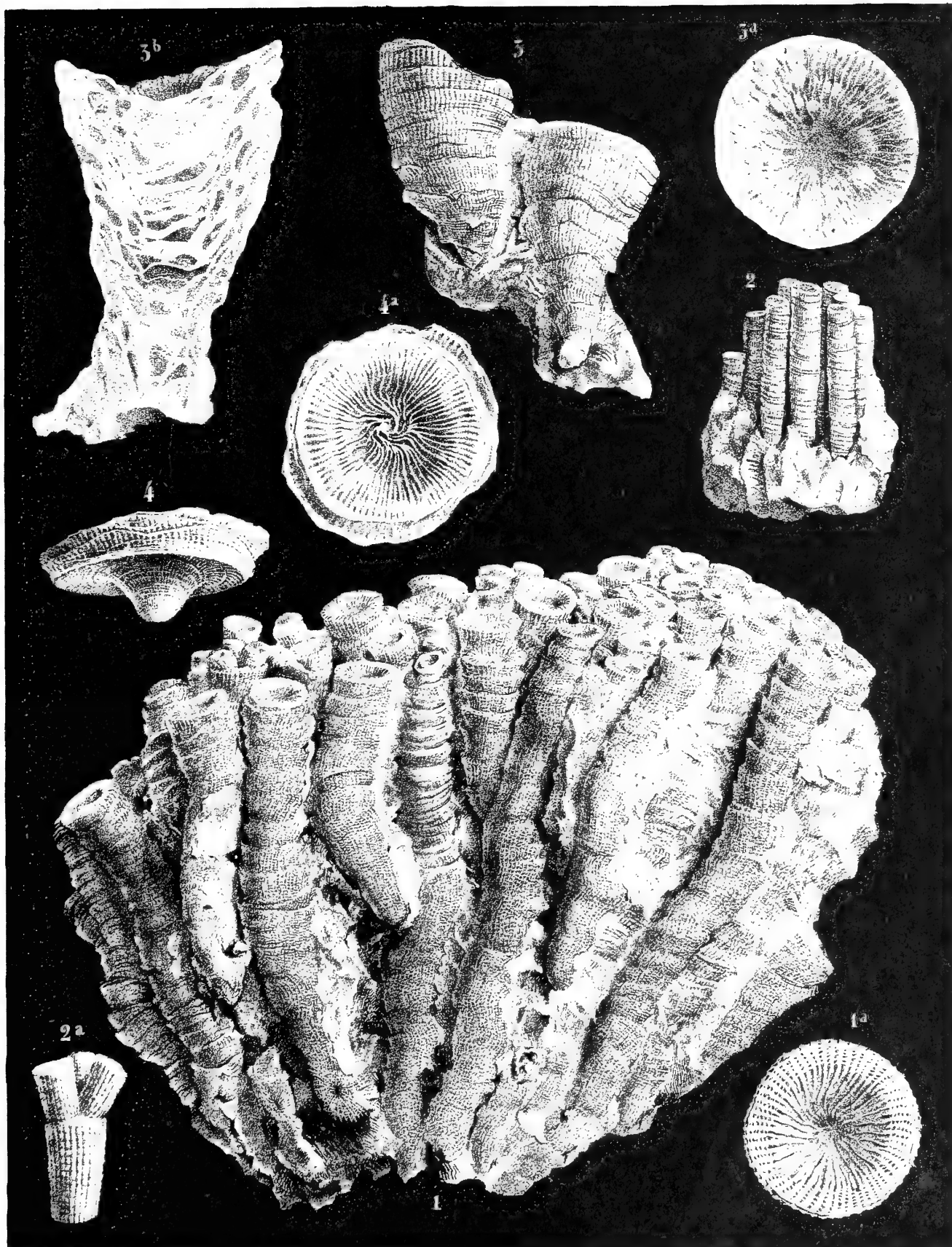
3*a*. Calice, magnified.

3*b*. Vertical section, somewhat magnified.

PTYCHOPHYLLUM PARTELLATUM (p. 291).

Fig. 4. Side view of a specimen from Malvern, belonging to the Collection of the Geological Society of London; natural size.

4*a*. Upper surface of the same; natural size.



Day 4 - on flight to the desert

TAB. LXVIII.

CORALS OF THE SILURIAN FORMATION.

OMPHYMA SUBTURBINATA (p. 288).

Fig. 1. A large specimen found at Wenlock, belonging to the Collection of the Geological Society of London ; somewhat smaller than the natural size.

1*a*. A specimen found by us at Benthall Edge, and placed in the Museum of Paris ; natural size.

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1*c*. Calice ; natural size.

CHONOPHYLLUM PERFOLIATUM ? (p. 235 and p. 291).

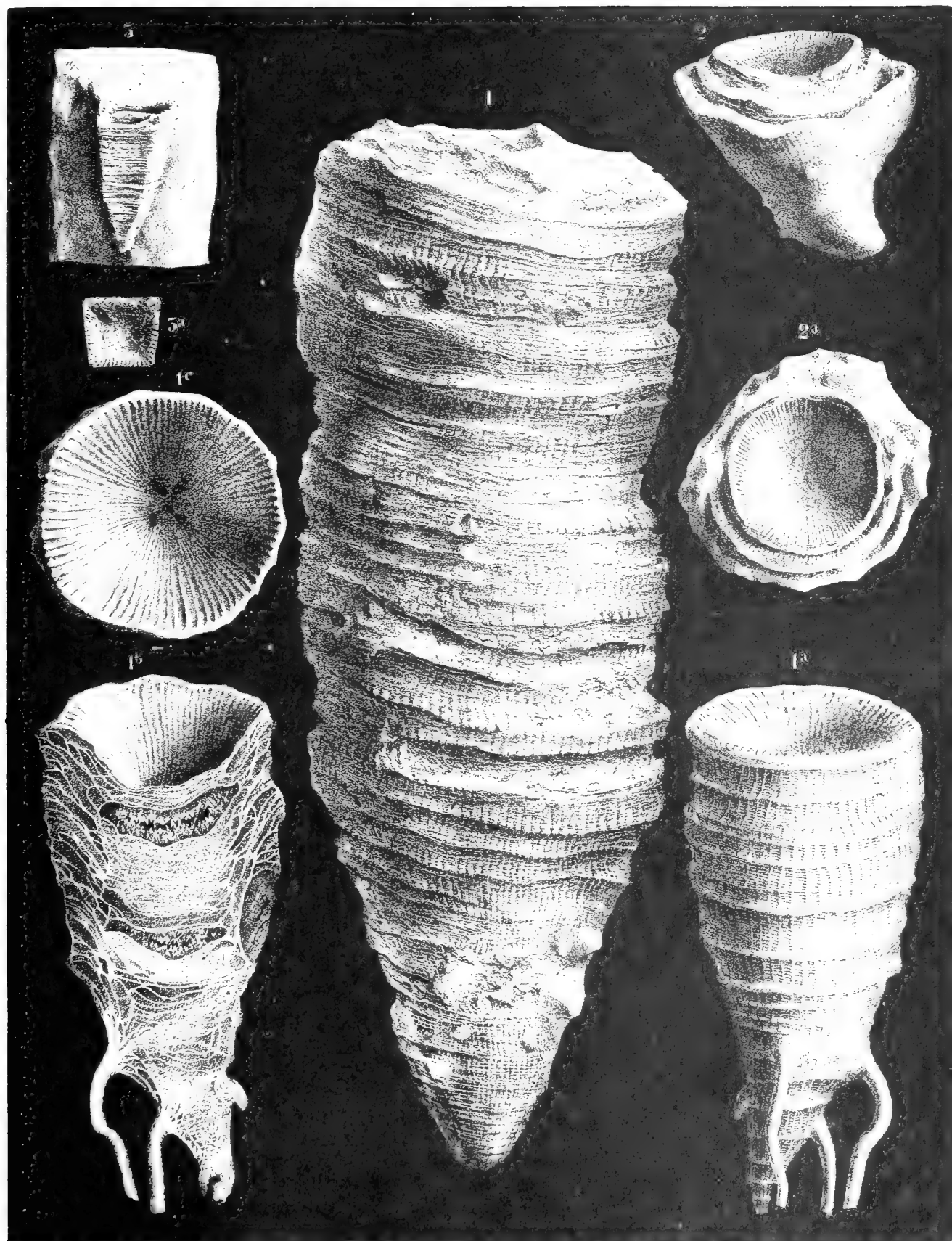
Fig. 2. Side view of a specimen from Wenlock, belonging to the Collection of the Viscount d'Archiac ; natural size.

2*a*. Its calice ; natural size.

GONIOPHYLLUM FLETCHERI (p. 290).

Fig. 3. Side view of a specimen found at Dudley, by Mr. Fletcher ; natural size.

3*a*. Its calice ; natural size.



TAB. LXIX.

CORALS OF THE SILURIAN FORMATION.

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1*a*. Its calice ; natural size.

ALCERVULARIA LUXURIANS (p. 292).

Fig. 2. Under surface of a specimen found at Dudley.

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Mr. Fletcher ; natural size.

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2*e*. Calices of the same, magnified.

2*f*. Some calices of a specimen from Dudley, belonging to the Collection of Mr.
Bowerbank ; natural size

TAB. LXX.

CORALS OF THE SILURIAN FORMATION.

STROMBODES MURCHISONI (p. 293).

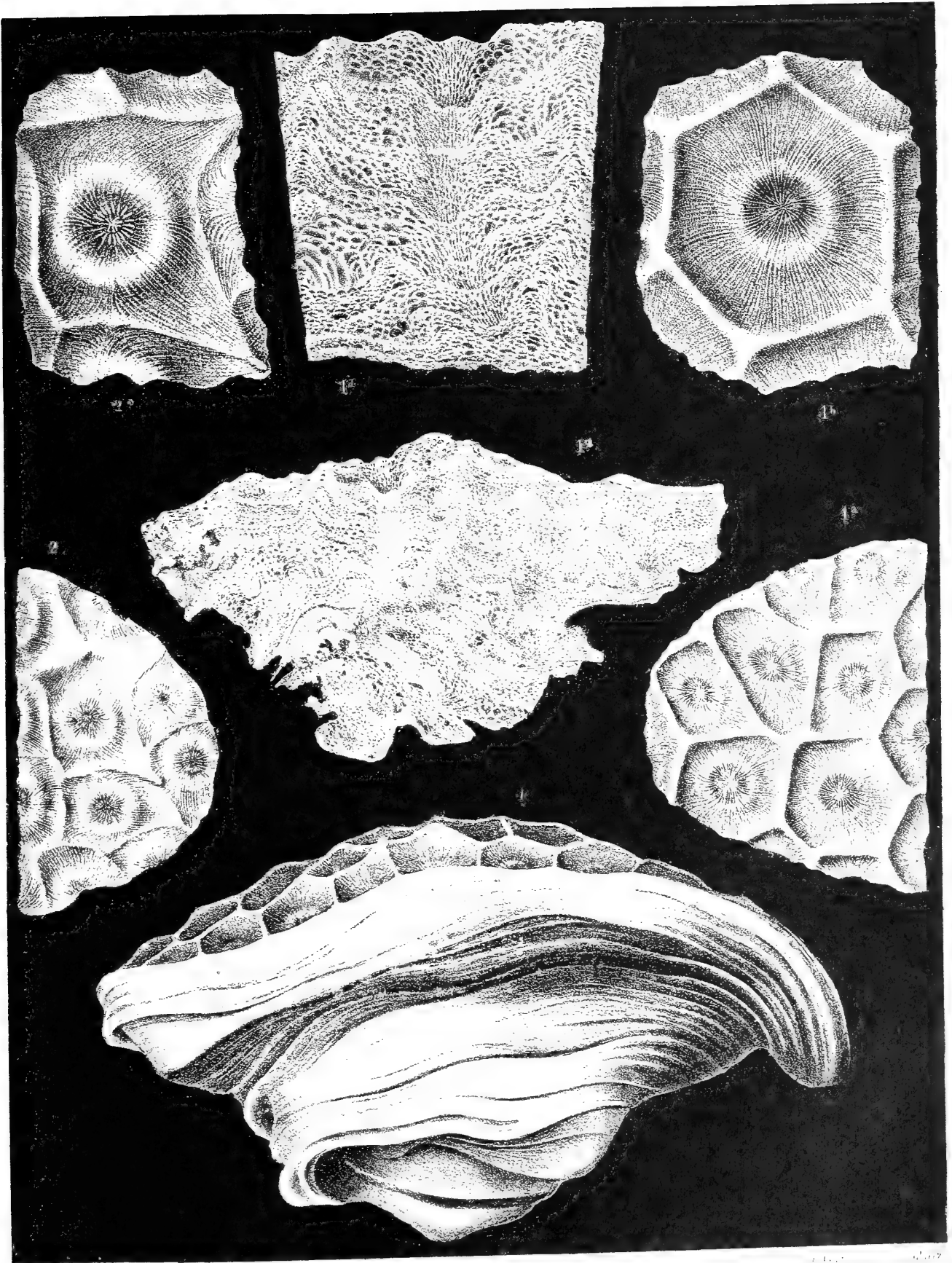
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- 1*a*. Some calices ; natural size.
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- 1*c*. Vertical section ; natural size.
- 1*d*. A portion of this vertical section, magnified.

STROMBODES PHILLIPSI (p. 294).

Fig. 2. Upper surface of a specimen found at Wenlock, belonging to the Collection of Professor Phillips ; natural size.

- 2*a*. A calice, magnified.



TAB. LXXI.

CORALS OF THE SILURIAN FORMATION.

STROMBODES TYPUS (p. 293).

Fig. 1. A part of the surface of a specimen from Wenlock, belonging to the Museum of Paris; natural size.

1*a*. A calice, magnified.

2*b*. A part of a vertical section, magnified.

STROMBODES DIFFLUENS (p. 294).

Fig. 2. Upper surface of a specimen found at Much Wenlock, belonging to the Parisian Museum; natural size.

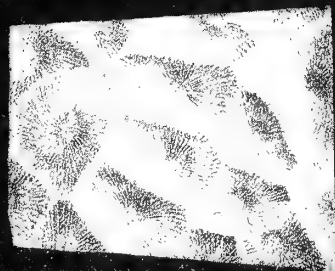
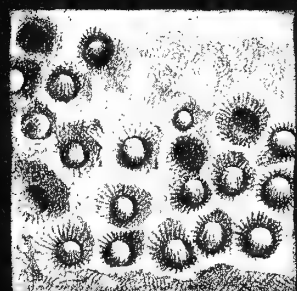
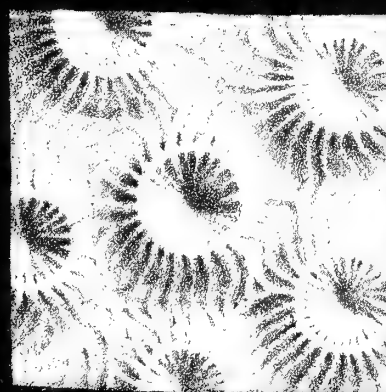
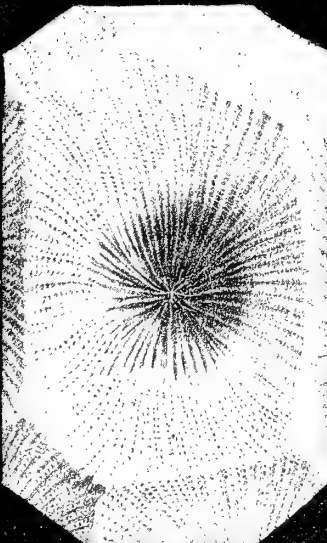
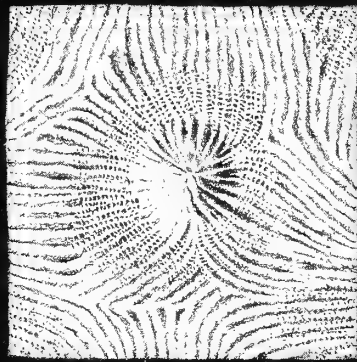
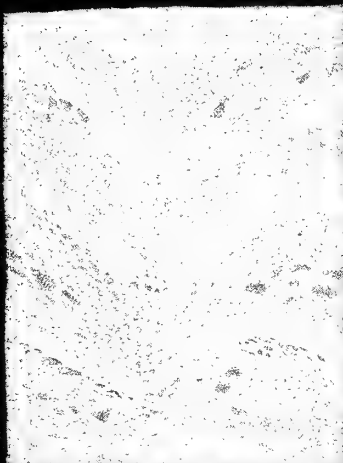
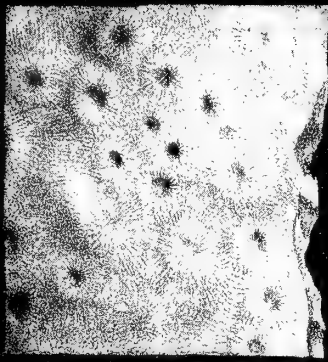
2*a*. A calice, magnified.

SYRINGOPHYLLUM ORGANUM (p. 295).

Fig. 3. A large specimen from Dudley; natural size.

3*a*. Calice, magnified.

3*b*. A cast found at Coniston, belonging to the Collection of the Geological Society of London.



TAB. LXXII.

CORALS OF THE SILURIAN FORMATION.

CYSTIPHYLLUM SILURIENSE (p. 297).

Fig. 1. Side view of a specimen from Wenlock, belonging to the Geological Society of London; natural size.

1*a*. Vertical section; natural size.

CYSTIPHYLLUM CYLINDRICUM (p. 297).

Fig. 2. A subturbinate specimen from Dudley, belonging to the Geological Society of London; natural size.

2*a*. Vertical section, amplified.

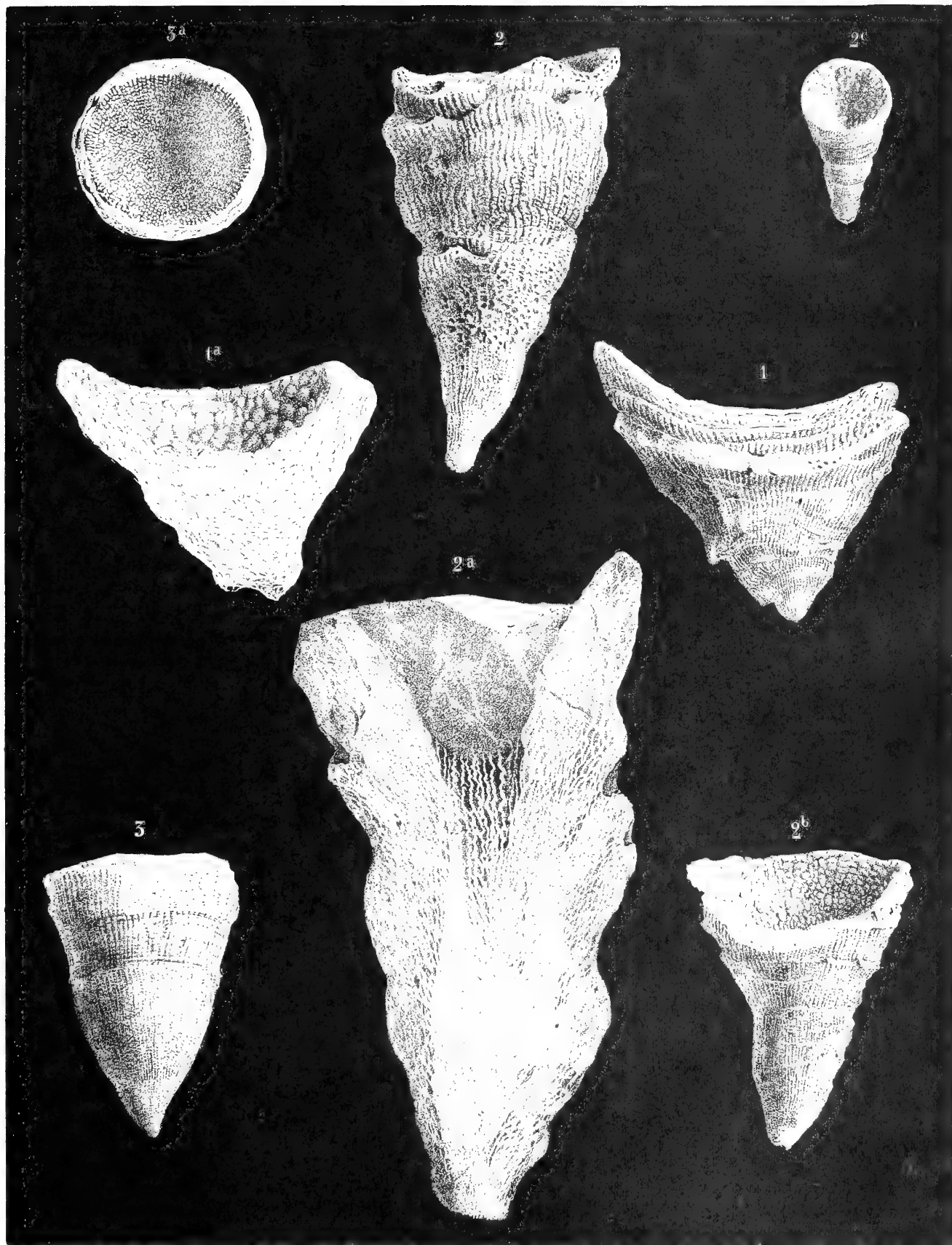
2*b*. A broken specimen found at Dudley, by Mr. Fletcher; natural size.

2*c*. A young specimen from the same locality and Collection; natural size.

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Fig. 3. A specimen from Dudley, belonging to the Collection of Mr. Fletcher; natural size.

3*a*. Its calice; natural size.



TABLE

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A MONOGRAPH

OF THE

BRITISH FOSSIL CORALS.

BY

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COPENHAGEN, VIENNA, KONIGSBERG, MOSCOW, BRUXELLES, HAARLEM, BOSTON, PHILADELPHIA, ETC.,

AND

JULES HAIME.

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A MONOGRAPH

ON THE

FOSSIL BALANIDÆ

AND

VERRUCIDÆ

OF

GREAT BRITAIN.

BY

CHARLES DARWIN, F.R.S., F.G.S.

LONDON :

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PREFACE.

As the present short Monograph completes my work on British Fossil Cirripedes, I beg to be permitted again to have the satisfaction of returning my very sincere thanks to the many naturalists who have placed their collections at my disposal, and have given me the freest permission to use the specimens, in whatever manner I might find necessary. —My thanks are most especially due to Mr. Searles Wood, Mr. Bowerbank, and Sir Charles Lyell; and to Mr. J. de C. Sowerby for the use of the original specimens figured in the 'Mineral Conchology.' I lie, also, under much obligation to Mr. D. Sharpe, Mr. Greenough, Mr. Smith of Jordan Hill, Professor Tennant, Mr. Charlsworth, Mr. F. Edwards, Dr. T. Wright, Professor Forbes, Professor Henslow, M. Bosquet, and to many others. I must, also, be permitted to tender my grateful thanks to the Council of the Palæontographical Society for the very liberal manner in which they have allowed my two Monographs to be illustrated.

INTRODUCTION.

CIRRIPIEDIA may be divided, as I have recently shown in a monograph on the Balanidæ published by the Ray Society, into three Orders: of these, the Thoracica includes all ordinary Cirripedes, and all ever likely to be found fossil, and therefore the two other orders may be here passed over without notice. The Thoracica contains three Families: the Balanidæ or Sessile Cirripedes, which in a recent state so abound on the shores of almost every quarter of the world, and which are so frequently found in Tertiary deposits; the Verrucidæ, which includes only a single genus very singular from its asymmetrical shell; and the Lepadidæ, or Pedunculated Cirripedes; of the latter, the Fossil species have been already published by the Palæontographical Society. The Balanidæ and Verrucidæ will be treated of in the following pages. As yet only sixteen species in these two families have been found fossil in Great Britain; and of these sixteen, nine are still living forms. As the latter are known only imperfectly in their fossil condition, and as they have lately been described by me in full detail, I have thought it best here only to make a few remarks on such portions of the shells of each species as have hitherto been discovered, adding a few illustrations, such as appeared to me desirable. The extinct species will be fully described: of these, all the figures given are from British specimens. But of the species found both living and fossil, I have in several instances (always so stated) given drawings from recent specimens; some of the valves either not having been found fossil, or found only in an imperfect and not characteristic condition. As so few species in the several genera are known in a fossil condition, I have thought it quite superfluous to give long generic descriptions, which would have required constant references to many species exclusively found living.

In my former monograph on the Fossil Lepadidæ, I remarked how much the natural

history of Cirripedes has been neglected; and this remark is eminently applicable to the Balanidæ, or Sessile Cirripedes. Even the British recent species have not been well made out, and as for the fossil species, scarcely anything has been done, besides the publication of some figures, in very few instances accompanied by the details which are absolutely necessary for the identification of the species.

Owing to the great variation in external characters, to which almost all the species are subject, and likewise in the case of the principal genus, *Balanus*, to its being a very natural genus, that is, to the species following each other in close order, it is not easy to exaggerate the difficulty of identifying the species, except by a deliberate examination of the internal and external structure of each individual specimen. Every one who has collected Sessile Cirripedes must have perceived to what an extent their shape depends on their position and grouping. The surface of attachment has a great effect on that of the shell; for as the walls are added to at their bases, every portion has at one time been in close contact with the supporting surface; thus I have seen a strongly-ribbed species (*B. porcatus*) and a nearly smooth species (*B. crenatus*) closely resembling each other and both having a peculiar appearance, owing to their having been attached to a pecten. Dr. Gray has pointed out to me specimens of the recent *B. patellaris*, curiously pitted like the wood to which they had adhered; and numberless other instances might be added. Quite independently of the effect produced by the surface of attachment, the degree to which the longitudinal folds and ribs are developed on the parietes, is variable in most of the species, as in *B. tintinnabulum* and even in *B. porcatus*; the presence or entire absence of these ribs often surprisingly alters the whole aspect of the shell. The persistence of the so-called epidermis is in some degree variable, though this is of little importance in regard to fossil specimens. Again, some species in certain localities are all subject to the disintegration of the entire outer lamina of the walls; and in such cases (as with *B. perforatus*) there is not the smallest resemblance between the corroded and perfect specimens. The size of the orifice, and consequently of the operculum, compared with the shell, varies accordingly as the shell is more or less conical or cylindrical; in the latter case, the summits of the radii are generally more oblique and the orifice consequently more deeply toothed than in the more conical varieties. Size is a serviceable character in some cases, but very many specimens are required to ascertain the average or maximum size of each species, for there is no method of distinguishing a half-grown from a full-grown specimen; and I believe, as long as the individual lives, so long does it go on growing. *Colour* is of very considerable service; but the majority of the species have their white or nearly white varieties, the latter being sometimes as numerous as the coloured ones.

Besides the slight variation in the obliquity of the summits of the radii and alæ, dependent on the more or less cylindrical form of the shell, in some species, as in *B. tintinnabulum* and *porcatus*, their obliquity also varies occasionally from unknown causes,

and thus greatly affects the general appearance of the shell. In some few species, as in *B. perforatus*, the radii are often either not at all developed, or are of very variable width; in others, when the shell has become cylindrical, or when very old, the radii cease to grow, and from the disintegration of the whole upper part of the shell, with the continued growth of the lower part, the radii at last come to exist as mere fissures: I have seen instances of this in *B. tintinnabulum* and *porcatus*. Nevertheless, the obliquity of the upper margin, and the breadth of the radii are useful characters; and still more useful is the fact whether the upper margins are smooth and arched, or straight and jagged. The fact of the terga being more or less beaked is useful: as is, likewise, the presence of striæ, or furrows, or rows of pits, radiating from the apices of the scuta; but to ascertain the presence of these marks, it is almost invariably necessary to clean and examine the scuta with a lens; these ridges and furrows, moreover, in some species, as is strikingly the case with *B. tintinnabulum*, and in less degree with *B. concavus*, appear and disappear, and vary without any apparent cause.

Now if we reflect that form, size, state and nature of the surface, presence of epidermis, relative size of the orifice, presence of longitudinal ribs, tint, and often the existence of any colour, are all highly variable in most of the species; and that the obliquity of the summits of the radii, and the presence of longitudinal striæ on the scuta, are variable in some of the fossil species, we shall perceive how difficult it must ever be to distinguish the species from external characters. Let no one attempt to identify the species of this genus, without being prepared to separate, clean, and carefully examine with a microscope the basis and parietes, and both the under and upper surfaces of the opercular valves; for I feel convinced, that he will otherwise throw away much labour. Moreover, in many cases, it is almost necessary, on account of the variability of the characters, to possess several specimens. From these facts, I have not hesitated to use characters, for the identification of the species, which require close examination, though I would gladly have seized on external characters could I have found such even moderately constant.

The least varying, and therefore most important characters, must be taken from the internal structure of the parietes, radii, and basis: not that these characters are absolutely invariable; thus the porosity of the parietes is slightly variable in the recent *B. glandula*, and highly variable in the fossil *B. unguiformis*. The porosity of the basis is in some degree variable in *B. spongicola*. Characters derived from the general shape, and from the ridges and depressions on the under side of the scuta and terga, especially of the scuta, are highly serviceable; though even these are variable. The cause of the opercular valves offering more useful characters, as far as outline is concerned, than do the walls of the shell, is no doubt due to their being almost independent of any influence from the nature of the surface of attachment. Even the ridges and depressions on the under side of the scuta, which are in direct connexion with the muscles and soft parts of the animal, vary to a certain extent: thus the length and prominence of the adductor ridge is decidedly

variable in the fossil *B. concavus* and *tintinnabulum*; the size and form of the little cavity for the lateral depressor muscle varies in many species; so does the exact shape and degree of prominence of the articular ridge. There is one character in the terga, which at first would be thought very useful, namely, whether an open longitudinal furrow, or a closed fissure runs down outside the valve from the apex to the spur; but it is found that the furrow almost always gradually closes up during growth; and as a consequence of this, the width of the spur compared to that of the whole valve, as well as its distance from the basi-scutal angle, and the form of its basal extremity, all vary in some degree. The length of the spur sometimes varies considerably, as in *B. concavus*. The summits of the radii are apt to be oblique in the young of some species, whereas they are generally quite square in the old of the same. In some species the scuta become longitudinally striated only with age; on the other hand, in very young specimens of *B. tintinnabulum*, the scuta sometimes are deeply impressed by little pits placed in rows. I have already alluded to the longitudinal furrow on the tergum so entirely changing its character, owing to the edges becoming, during growth, folded inwards, and to the consequences which result from this. The inner lamina of the parietes generally loses, to a certain extent, its longitudinally ribbed character in old age. The basis is solid instead of being porose, in very young specimens of some species. In all the species, the carino-lateral compartments, in early age, are very narrow in proportion to the width of the lateral compartments; and in all, at this early period, the operculum is large in proportion to the whole shell.

Finally, I must state my deliberate conviction that Sessile Cirripedes can very seldom be satisfactorily identified in a fossil condition, without an examination of the opercular valves: hence when these have not been discovered, I have resolved, with some rare exceptions, not to attach a specific name to a shell without its operculum; for thus, I believe, I should add to the number of useless synonyms, which, as we shall immediately see, already exist. Nothing, indeed, could have been easier than to have affixed names to many groups of specimens, having different aspects, but to feel sure that these were really distinct species requires better evidence than can be afforded by the shell, without the opercular valves. When the specimens are much fossilised, it is, indeed, difficult to make out the primary points of structure in the genus *Balanus*—namely, whether the parietes, radii, and basis are porose: to do this it is sometimes necessary to rub down, polish, and carefully examine, a transverse section of a piece of the shell.

The ancient history of the Balanidæ is a brief one. No Secondary species has hitherto been discovered; in my former monograph on the fossil Lepadidæ¹ I have shown that the negative evidence in this case is of considerable value, and consequently that there is much reason to doubt whether any member of the family did exist before the eocene period.

¹ Since the note to page 5 of that work was written, I have been informed that the so-called cretaceous *Tubicinella maxima* is not a Cirripede.

The existence of a Cretaceous Verruca is an apparent exception to the rule, as this genus has hitherto always been ranked among Sessile Cirripedes; but Verruca, as we now know, must be placed in a family by itself, namely, the Verrucidæ, quite distinct from the Balanidæ. Balanus is the oldest genus as yet known; it first appeared in Europe and North America, during the deposition of the eocene beds; and was at that time, as far as our information at present serves, represented by very few species. In South America, one species of Balanus abounds in individuals in the ancient Patagonian tertiary formation. I have seen, in the British Museum, specimens said to have come from the eocene nummulitic beds, near the mouth of the Indus, belonging to that section of the genus, which has the walls and basis permeated by pores. Generally, the extinct forms belong to the section, which has the parietes not permeated by pores. During the miocene and pliocene ages, Sessile Cirripedes abounded. No extinct genus in this family has hitherto been discovered. It is singular, that though the Chthamalinæ approach much more closely than do the Balaninæ to the ancient Lepadidæ, of which so many species have been found fossil even in the older Secondary formations, yet that only one species of one genus of this sub-family has been hitherto found in any deposit; and that species is the still existing *Pachylasma giganteum*, in the modern beds of Sicily. During the epoch of the Glacial deposits in Scandinavia, Scotland, and Canada, the still existing species seem to have abounded; and they attained larger average dimensions than the same species now do on the shores of Great Britain, or even on the shores of the northern United States, where the average size seems larger than on this side of the Atlantic.

I already have given my reasons for very seldom naming any Sessile Cirripede without examining the opercular valves: it has been owing to this, as it appears to me, proper want of caution, that there are so many nominal species. Thus it is made to appear in catalogues, that the tertiary seas abounded with species of Balanus to an extent now quite unparalleled in any quarter of the world. Bronn,¹ for instance, in his invaluable 'Index Palæontologicus,' gives the names of thirty-five Balani, found fossil in Europe, and I have not counted those found only in alluvial deposits, as they would certainly be the same as the still living species. Now I know only eleven recent Balani on the shores of all Europe, from the North Pole to lat. 30°; and of these I doubt whether *B. balanoides* and *improvisus* have been found fossil. In the Red Crag there is one extinct Balanus: in the Coralline Crag, which seems to have been very favorable to the existence of Cirripedes, there are six species of Balani, of which two are absolutely extinct, and one does not occur in any neighbouring sea: in the Eocene formations the species seem to have been rare, and I have seen only one, and that is an extinct form. Taking these several facts into consideration, and bearing in mind that Cirripedes usually range widely,

¹ To save any other person interested in fossil Cirripedia, going through the several works quoted by Bronn, I have given some remarks on his list of species, in an appendix at the end of the Balanidæ, in my volume published by the Ray Society.

I do not believe, if all the specimens of Balani hitherto found in the several tertiary formations, from the Eocene to the Glacial deposits, throughout Europe, were collected together, they would amount to twenty species. I have myself seen, in a recognisable state, only twelve fossil species, of which five are extinct or not found in any neighbouring sea: I think it probable that three other recent species, viz., *B. tulipiformis*, *perforatus*, and *amphitrite*, may occur in the Mediterranean formations: and this would make fifteen species. Therefore, in the above estimate of twenty species, five are allowed for species existing in European collections, but not hitherto seen by me; and this, I believe, is a very full allowance. Consequently, even on the supposition that the five species just admitted as possibly existing in cabinets, and that the other five extinct species, which I have seen and examined, have all been previously named by other authors, a supposition excessively improbable, even then there would be fifteen superfluous names in Bronn.

The following short table shows how the Balanidæ and Verrucidæ were represented in Great Britain, throughout the several TERTIARY STAGES. It includes all the sixteen species described in the following pages, with the exception of one, the cretaceous *Verruca prisca*, which is the only member of either family hitherto found in any Secondary deposit.

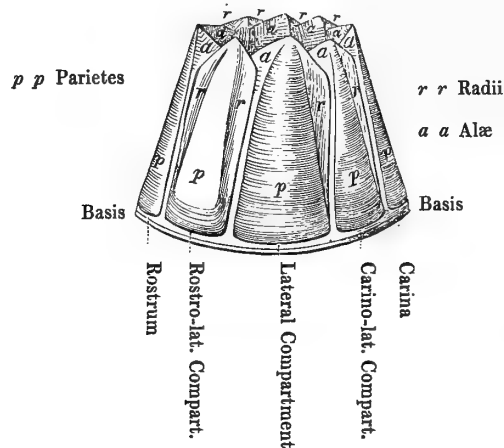
Name.	Living species, but found fossil in some tertiary deposits.	Mammaliferous crag, and glacial deposits.	Red crag.	Coralline crag.	Eocene.
<i>Balanus tintinnabulum</i> . .	*	..	*	..	..
<i>calceolus</i> . .	*	..	..	*	..
<i>spongicola</i> . .	*	..	..	*	..
<i>concavus</i> . .	*	..	*	*	..
<i>porcatus</i> . .	*	*	*	..	..
<i>crenatus</i> . .	*	*	*	*	..
<i>Hameri</i> . .	*	*	*	..	..
<i>bisulcatus</i> . .	..	..	..	*	..
<i>dolosus</i> . .	..	*	*	..	..
<i>inclusus</i> . .	..	..	..	*	..
<i>unguiformis</i> . .	..	..	..	..	*
<i>Acasta undulata</i> . .	..	..	..	*	..
<i>Pyrgoma anglicum</i> . .	*	..	..	*	..
<i>Coronula barbara</i> . .	..	..	*	..	..
<i>Verruca Strömia</i> . .	*	*	*	*	..
Total 15, recent and extinct, found fossil in Great Britain, in some tertiary deposit .	9	5	8	9	1

As affording some standard of comparison by which to compare the number of species found fossil in any Tertiary deposit, in relation to the number of species probably existing in the neighbouring seas during the same epoch, I may state that there are now living and propagating on the shores of Great Britain, eleven species belonging to the two Families included in the above table. In the Coralline crag, which seems to have been eminently favorable for the existence and subsequent preservation of Cirripedes, and which has been so well worked, nine fossil species of these two families, as may be seen in the table, have been discovered.

NOMENCLATURE OF THE SHELL OF A SESSILE CIRRIPEDE.

ARCHETYPE SHELL. Fig. 1.

Orifice of shell, surrounded by the *sheath*. *Sheath* formed by the *alæ* (*a—a*) and by portions of the upper and inner surfaces of the *parietes* (*p—p*).



N. B. In *Balanus*, and all known fossil genera, the Rostrum and Rostro-lateral compartments are confluent, and hence the Rostrum has the structure of Fig. 2.

COMPARTMENTS.

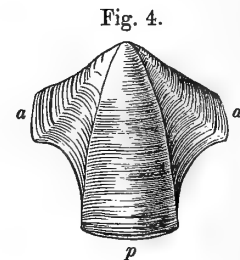
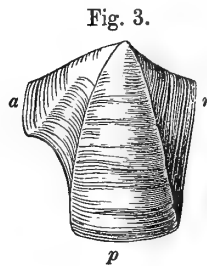
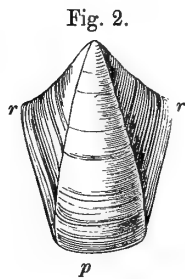


Fig. 2. Compartment with two radii, serving, in fossil specimens, always as a Rostrum. Fig. 3 serves as a Lateral and Carino-lateral Compartment. Fig. 4 serves as a Carina.

OPERCULAR VALVES.

Fig. 5. SCUTUM (internal view).

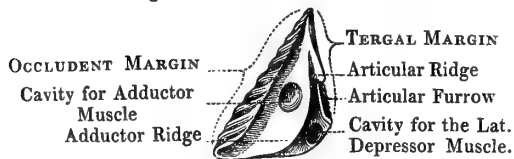


Fig. 6. TERGUM (internal view).

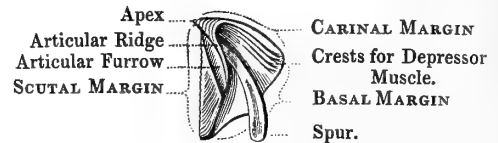
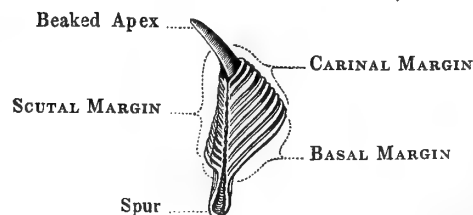


Fig. 7. TERGUM (external view).



On the Names given to the different parts of Cirripedes.

In my former volume I stated that I had found it indispensable, in part owing to the extreme confusion of the nomenclature previously used, to attach new names to several of the external parts of Cirripedes. Almost all these names are applicable to the Balanidæ, or Sessile Cirripedes, and to the Verrucidæ; but a few additional names are requisite, which, together with the old names, will, I hope, be rendered clear by the accompanying woodcuts. In Sessile Cirripedes, the whole of that which is externally visible, may, for convenience sake, be divided into the *operculum* or *opercular valves* (*valvæ operculares*), and the *shell* (*testa*), though these parts homologically present no real difference. The operculum is seated generally some little way down within the *orifice* of the shell; but in very young specimens, and in Verruca, the operculum is attached to the summit of the shell, and in these cases the shell, without the operculum be removed, can hardly be said to have any orifice; though, of course, the opercular valves themselves have an aperture for the protrusion of the cirri.

The shell consists of the *basis* (called the support by some authors), and of the *compartments* (*testæ valvæ*), which in recent specimens vary from eight to four in number, and occasionally are all calcified together.

The compartment, at that end of the shell (fig. 1) where the cirri are exerted through the aperture or lips of the operculum, is called the *carina* (fig. 4); the compartment opposite to it, is the *rostrum* (in all fossil specimens, like fig. 2),—these two lying at the ends of the longitudinal axis of the shell. Those on the sides are the *lateral compartments*; that nearest the carina, being the *carino-lateral* (fig. 3) (*testæ valva carino-lateralis*), that nearest the rostrum, the *rostro-lateral*, and middle one simply the *lateral* compartment (fig. 3): but these three compartments are rarely present together. The *rostro-lateral* compartment, which always resembles fig. 2, and may be always known by having radii on both sides, is not known to occur in any fossil species; and hence we are here only concerned with the lateral and carino-lateral compartments. The compartments are separated from each other by *sutures*, which are often so fine and close as to be distinguished with difficulty. The edge of a compartment, which can only be seen when disarticulated from its neighbour, I have called the sutural edge (*acies suturalis*).

Each separate *compartment* consists of a *wall* (*paries*), or *parietal portion* (*pp* in figs. 1 and 4), which always grows downwards, and forms the basal margin; and is furnished on the two sides either with *alæ* (fig. 4), or with *radii* (fig. 2), or with an ala on one side and a radius (fig. 3) on the other.

The *radius* (adopting the name used by Bruguière, Lamarck, and others) differs remarkably in appearance (though not in essence) from the wall or parietal portion, owing to the direction of the lines of growth and the state of its usually depressed surface. In the upper part, the radii overlie the alæ of the adjoining compartments: in outline

(*r*, fig. 2, 3), they are wedge-formed, with their points downwards; their summits (and this is often a useful specific character) are either parallel to the basis, or as in fig. 1, 2, oblique. The radii are sometimes not developed.¹

The *alæ* (so called by Dr. Gray) are overlapped by the radii, and by part of the walls; they usually extend only about half way down the compartment (*a*, fig. 3, and 4); their summits are either parallel to the basis or oblique. The *alæ* of the several compartments, together with the internal, upper, thickened surfaces of the walls, against a shoulder of which the sutural edges of the *alæ* abut, have been called (by Dr. Gray) the *sheath* (*vagina*). The upper and greater portion of the sheath is marked by transverse lines, caused by the exuviation of the *opercular membrane*, as that membrane may be called, which unites the operculum all round to the sheath, or upper internal surface of the shell.

The *carina* has always two *alæ*, as in fig. 4.

The *carino-lateral* and *lateral compartments* have always an *ala* on one (the rostral) side, and a *radius* on the other (the carinal) side, as in fig. 3.

The *rostro-lateral compartment* (not at present known to occur in any fossil) has always *radii* on both sides, as in fig. 2.

The *rostrum* has normally *alæ* on both sides, as in fig. 4; but in many recent, and all the fossil species yet known, it has *radii* on both sides, as in fig. 2, owing to its fusion with the rostro-lateral compartments on both sides.



Basal edge of wall of compartment in *Balanus tintinnabulum*. *a*, *a*, outer lamina; *b*, *b*, inner lamina; *c*, *c*, longitudinal septa, uniting the inner and outer laminae, with their ends denticulated.

The walls of the shell, the basis, and the radii, are in very many cases composed of an *outer* and *inner lamina*, united together by *septa*; a set of pores or tubes being thus formed. The points of the septa generally project beyond the laminae, and are denticulated on both sides, as shown in the accompanying woodcut.

Operculum, or *opercular valves*.—These consist of a pair of scuta and a pair of terga. They are joined to the sheath of the shell by the *opercular membrane*.

Scutum (fig. 5): this valve is generally sub-triangular, and its three margins are the *basal*, the *tergal*, so called from being articulated with the tergum, and the *occludent*, so called from opening and shutting against the opposed valve. The angles are named, from the adjoining margins, as *basi-tergal*, &c.; the upper angle being the apex. The scutum is ordinarily articulated to the tergum by an *articular ridge* (*crista articularis*), running up to the apex of the valve, and by an *articular furrow*, which latter receives the

¹ The radii have been called by Ranzani and De Blainville "*areæ depressæ*" (the parietal portions of the compartments being the "*areæ prominentes*"); by Poli, "*areæ interjectæ*;" by Gray, "*sutures*;" by Coldstream, "*compartments of the second order*," (the parietal portions being those of the first order); by some authors, "*intersticia*." I may here add that the scuta are the "*ventral valves*" of Gray, the "*anterior*" of Ranzani, and the "*inferior opercular*" of De Blainville: the terga are the "*posterior valves*" of Gray and Ranzani, but the "*superior opercular*" of De Blainville: the rostrum, on the other hand, is the "*anterior valve*" of Ferussac, and the "*ventral*" of De Blainville; the carina being the "*dorsal valve*" of the latter author.

scutal margin of the tergum. The articular ridge, instead of projecting straight up from the valve, when the latter is laid flat on its external surface, often bends over to the tergal side, and is then said to be *reflexed*. On the internal surface of the valve there is almost always an *adductor pit* or *cavity* (*fossa adductoris*), for the attachment of the adductor scutorum muscle: this pit is often bounded on its tergal and basal sides, by a ridge, called the *adductor ridge* (*crista adductoris*), which, in its upper part, is often confluent with the articular ridge. Beneath the adductor ridge, in the basi-tergal corner of the valve, there is often a *lateral-depressor pit* (*fossa musculi lateralis depressoris*), for the attachment of the so-called muscle; and this pit is sometimes furnished with crests.

Tergum, (figs. 6 and 7):—this valve, also, has three margins, the *scutal*, *basal*, and *carinal*; its upper end, or *apex*, is sometimes *beaked*; on the basal margin a *spur* (*calcar*) depends; the outer surface of the valve is depressed or longitudinally *furrowed* (*sulcus longitudinalis*) in the line of the spur. The part called the spur is often so broad, that the name becomes not very appropriate. The angles are denominated, from the adjoining margins, as *basi-carinal*, or *basi-scutal* angle, &c. On the under side, in the upper part, there is an *articular ridge*, and on its scutal side, an *articular furrow*, receiving the articular ridge of the scutum. In the basi-carinal corner of the valve there are often crests for the attachment of the tergal depressor muscle.

Relative position of parts.—The centre of the generally flat basis, which is cemented to the supporting surface, is properly the *anterior* end, and the tips of the terga, often hidden within the shell, are properly the *posterior* end of the external covering; but I have found it more convenient to speak of the *upper* and *basal* surfaces and aspects, which hardly admit of any mistake. A line drawn from the centre of the basis, along the middle of the rostrum to the tips of the scula, shows the strictly *medio-ventral* surface of the shell; and another line drawn from the centre of the basis, along the carina, to the tips of the terga, shows the strictly *medio-dorsal* line; but from the crooked course of these lines, I have found it far more convenient to speak of the *rostral* and *carinal* end or aspect of the different parts of the shell. There has, moreover, been great confusion in these relative terms, as applied by different authors.

When a sessile Cirripede is held in the position in which they have generally been figured, namely with the basis downwards and the scuta towards the beholder, then the *right* and *left* sides of the Cirripede correspond with those of the holder.

SUB-CLASS—CIRRIPIEDIA. ORDER—THORACICA.

Family—BALANIDÆ.

Cirripedia sine pedunculo; scuta et terga musculis depressoribus instructa; reliquæ testæ valvæ inter se immobiliter conjunctæ.

Cirripedia without a peduncle; scuta and terga furnished with depressor muscles; other valves united immoveably together.

This family, which includes all true Sessile Cirripedes, may be divided into two very natural sub-families; namely, the Balaninæ and Chthamalinæ; but as not one member of the latter has been found fossil in Great Britain, and indeed only one, the *Pachylasma giganteum*, in any part of the world, viz., in the recent beds of Sicily, this sub-family of the Chthamalinæ may be here passed over in silence.

Sub-Family—BALANINÆ.

Rostrum cum radiis, sed sine alis: valvæ testæ laterales omnes, ex uno latere alis, ex altero radiis instructæ: parietes ferè aut porosi, aut ad interiorem superficiem longitudinaliter costati.

Shell with the rostrum having radii, but without alæ; lateral compartments all having alæ on one side and radii on the other side; parietes generally either porose, or longitudinally ribbed on their inner surfaces.

Genus—BALANUS, *Auct.*

CONOPEA (pars generis). *Say.* Journal Nat. Sc. Philadelphia, vol. ii, Part 2, 1822.

MESSULA (do.) *Leach.* Zoological Journal, vol. ii, 1825.

CHIRONA (do.) *J. E. Gray.* Philosoph. Transacts., 1835, p. 37.

Valvæ operculares inter se articulatæ, subtriangulares; valvæ testæ 6; basis calcarea aut membranacea.

Scutum and tergum articulated together, sub-triangular; compartments six; basis calcareous or membranous.

The genus *Balanus* already includes 45 species, recent and fossil, and consequently in my volume published by the Ray Society, I have divided the genus into sections, on characters derived from the porosity of the parietes, radii, and basis; and on whether the basis be membranous or calcareous. But as here we have to describe or notice only eleven species, I have thought it more convenient to drop the sections, and in their place add a few words to each of the diagnostic characters. The genus is quite distinct from all the other genera of Sessile Cirripedes, with the exception of the sub-genus *Acasta*, from which its separation, it must be confessed, is in one sense artificial; for the species of this sub-genus graduate into those of *Balanus* (such as *B. calceolus* and its allies), which have their shells elongated in the rostro-carinal axis, and which live attached to *Gorgoniæ*. These latter species have been generically separated by some authors from true *Balanus*; but I have found it impossible to effect this; and even the section of the genus, including these species, is hardly distinct enough from the adjoining sections. On the other hand, the sub-genus *Acasta*, in another sense, is a very natural one, inasmuch as all its species are closely allied together in essential structure, in general appearance, and in habit; and as the genus *Balanus* is already large, I have thought it best to adopt *Acasta*, which has been already admitted by many authors as a sub-genus. I need only further remark, that from reasons already assigned, I have thought it useless to give in this work long generic descriptions.

1. *BALANUS TINTINNABULUM*. Tab. I, fig. 1*a*—1*d*.

- LEPAS TINTINNABULUM*. Linn. Syst. Naturæ, 1767.
 — — Ellis. Phil. Transact., vol. 50, 1758, Tab. 34, figs. 8 and 9.
 — — Chemnitz. Neues. Syst. Conch., 8 B. (1785), Tab. 97, figs. 828–831.
BALANUS TULIPA. Bruguière. Encyclop. Meth., 1789; sed non *B. tulipa alba*, in Chemnitz; nec non *B. tulipa*, O. F. Müller, Zoolog. Dan.; nec non *B. tulipa*, Poli, Test. ut Siciliæ.
 — — G. B. Sowerby. Genera of Recent and Fossil Shells, Tab. Genus *Balanus*.
LEPAS CRISPATA (var.) Schröter. Einleitung Conch., vol. iii, Tab. 9, fig. 21.
 — *SPINOSA* (var.) Gmelin. Linn. Syst. Nat.
 — *TINTINNABULUM*, *SPINOSA*, *CRISPATA* ET *PORCATA*. W. Wood. General Conchology, 1815, Pl. 6, figs. 1, 2. Pl. 7, figs. 4, 5. Pl. 8, figs. 1—5.
BALANUS TINTINNABULUM. Chenu. Illust. Conch.
 — *D'ORBIGNII* (var.) Chenu. Illust. Conch., Tab. 6, fig. 10, sed non Tab. 4, fig. 13.
 — *CRASSUS*. Sowerby (!) Min. Conch., 1818, Tab. 84.

B. parietibus et basi et radiis poris perforatis: testá a roseá ad atro-purpuream variante, sæpe longitudinaliter virgatá et costata: orificio plerumque integro, interdum dentato. Scuti cristá articulari latá et reflexá. Tergi margine basali plerumque in contrariis calcaris partibus rectam lineam formante.

Walls, basis, and radii permeated by pores; shell varying from pink to blackish purple, often striped and ribbed longitudinally; orifice generally entire, sometimes toothed. Scutum with the articular ridge broad and reflexed. Tergum with the basal margin generally forming a straight line on opposite sides of the spur.

Fossil in the Red Crag (Sutton). Mus. S. Wood, J. de C. Sowerby. Touraine (?) Mus. Lyell.

Recent, on West Coast of Africa; Madeira; West Indies; Cape of Good Hope; Mouth of the Indus; East Indian Archipelago; Sydney, Australia; Peru; Galapagos Islands; West Mexico; California.

Of this species I have seen several specimens, and fragments. Three of these are the original specimens figured in the Mineral Conchology, as *B. crassus*, an examination of which I owe to the great kindness of Mr. J. de C. Sowerby. Some specimens equally or more perfect are in Mr. S. Wood's collection. I have further seen a specimen from Touraine, which was presented to Sir C. Lyell by M. Dujardin, under the name of *B. fasciatus*, which I fully believe to be *B. tintinnabulum*. None of these specimens had opercular valves, and therefore it is perhaps rash to assert quite positively that they are identical with *B. tintinnabulum*; but, extraordinarily variable as this latter species is, yet, after having examined so many hundreds of recent specimens from all quarters of the globe, a sort of instinctive knowledge of general aspect is acquired, which makes me feel convinced that the fossils in question do really belong to this species. Moreover, the large shell, with its trigonal orifice passing into rhomboidal,—the smooth, broad, finely porose radii, with their summits not oblique,—the rather large parietal pores,—and the cancellated basis, are characters which hardly concur in any other species; and those with which these fossils might be confounded, are inhabitants of distant quarters of the world. Most of the recent varieties of *B. tintinnabulum*, and all the fossil specimens from the Crag, can be at once discriminated from *B. tulipiformis* (with which, at least in the Mediterranean deposits, it is likely to be confounded) by the summits of the radii extending from tip to tip of the adjoining compartments, and therefore not being oblique, as is always the case with the radii of *B. tulipiformis*. The largest fossil specimen which I have seen is nearly two inches in basal diameter, and nearly the same in height, and therefore about two thirds of the size of the largest living specimens.

I have had engraved, from recent specimens, an internal view of the scutum and tergum, as these are likely hereafter to be found by searchers in the Crag deposits; and I may refer to my Monograph on the Balanidæ for their full description. It may be observed in the habitats given of the living specimens, that Madeira is the nearest point where the species now lives and propagates; but specimens in full vigour are often brought to the British shores, attached to the bottoms of vessels.

2. *BALANUS CALCEOLUS*,* Tab. I, fig. 2a—2d.

BALANUS CALCEOLUS KERATOPHYTO INVOLUTUS (?) *Ellis*. Phil. Trans., vol. 50 (1758),
Tab. 34, fig. 19.

LEPAS CALCEOLUS (?) *Pallas*. Elench. Zooph., p. 198, (sine descript.) (1766).

CONOPEA OVATA (?) *J. E. Gray*. Annals of Philosophy, vol. 10, 1825.

B. testæ axe rostro-carinali elongato; basi cymbiformi; parietibus et basi, sed non radiis, poris perforatis. Scuto musculi depressoris lateralis fossâ parvâ, profundâ.

Shell with its rostro-carinal axis much elongated; basis boat-shaped; walls and basis porose, but not the radii. Scutum with the pit for the lateral depressor muscle small and deep.

Fossil in Coralline Crag, attached to a Gorgonia; Sutton; Mus. S. Wood.

Recent, attached to Gorgoniæ, West Coast of Africa. Tubicoreen, near Madras. Mediterranean (?).

I have seen only a single fossil specimen of this species, nearly half an inch in length. The shell was perfect, and a small portion of the Gorgonia yet remained attached to the grooved and boat-shaped basis. The opercular valves had been lost, but the shell in this instance is so peculiar, that it could only be confounded with the recent *B. galeatus*, *cymbiformis*, or *navicula*, and from all these it is easily distinguished by the parietes being permeated by pores. It is, of course, possible, that the opercular valves might present some new character, showing that this fossil, though agreeing with *Bal. calceolus* in its shell, yet was specifically distinct. I have given a drawing of the opercular valves from recent specimens, which have been fully described in my Monograph on the Balanidæ. In regard to the shell, the fossil specimen could not be distinguished from the recent; and as it had to be broken, in order that its internal structure might be examined, I have thought it best to give a drawing from a perfect recent specimen. The spur of the tergum, in recent specimens, sometimes presents a singular character, in being irregularly toothed, and I have given a drawing (fig. 2d) of this variety, as it might perplex a collector.

¹ With respect to the nomenclature of this and three allied recent species, I must remark that in the published descriptions no allusion is made to any one of the characters by which alone they can be distinguished: hence I have been guided by geographical probabilities in assigning the specific name of *calceolus* to the present species, as Ellis's specimens came from the Mediterranean; and that of *galeatus* to the North American and West Indian specimens, as Linnæus' original specimens (according to a statement by Spengler) came from the West Indies. I have assigned new names to the two remaining East Indian species.

3. *BALANUS SPONGICOLA*, Tab. I, fig. 3*a*—3*e*.

BALANUS SPONGICOLA. *Brown's Illustrations of the Conchology of Great Britain* (1827), pl. 7, fig. 6: 2d edit. (1844), pl. 53, figs. 14—16.

B. parietibus et basi, sed non radiis poris perforatis; parietibus plerumque lævibus, roseis; orificio dentato; scuto longitudinaliter striato; tergum, apice producto, sine sulco longitudinali, calcare truncato, $\frac{1}{3}$ valvæ latitudine.

Parietes and basis, but not the radii, permeated by pores; parietes generally smooth; shell pink; orifice toothed; scutum longitudinally striated; tergum, with the apex produced, without a longitudinal furrow; spur truncated, about one third of width of valve.

Fossil in Coralline Crag; Sutton; Mus. S. Wood.

Recent on the South coast of England, and Tenby in South Wales; Algiers; Madeira; Lagulhas Bank, Cape of Good Hope.

I have seen only a single specimen of this species, which I picked out of a mass of specimens of the extinct *Bal. inclusus*, collected by Mr. Wood, in the Coralline Crag at Sutton. This one specimen was perfect, and included the opercular valves; it even partially retained its rosy colour: it was $\cdot 3$ of an inch in basal diameter, and therefore exactly half the size of the largest recent specimen which I have seen. It was in every respect perfectly characterised. I have given drawings, external and internal, of the scutum and tergum from the fossil specimens. In the scutum, the adductor ridge is, perhaps, rather more prominent, and the pit for the lateral depressor muscle rather deeper than in recent specimens; but these points are extremely variable. The tergum, in its outline, strictly agrees with the European recent specimens, and not with those varieties from the Cape of Good Hope and West Indies; indeed, in the degree in which the basal margin on the carinal side of the spur slopes towards the spur, it even, perhaps, exceeds the European variety. These valves are fully described in my Monograph on the Balanidæ. From the shell alone, as viewed externally, *Bal. spongicola*, even in its recent state, can hardly be distinguished from *Bal. tulipiformis*, or from some varieties of *Bal. Capensis*: I doubt whether this species could anyhow be distinguished in its fossil condition from the young of the fossil *Bal. concavus*, without the aid of the opercular valves. But in order to give an idea of its general appearance, and as I was compelled to disarticulate the compartments of the one fossil shell, I have had a fine recent specimen from the Mediterranean engraved on an enlarged scale.

4. *BALANUS CONCAVUS*, Tab. I, fig. 4a—4p.

BALANUS CONCAVUS. *Bronn*. Italiens Tertiar-Gebilde (1831) et Lethæa Geognostica, b. ii, s. 1155 (1838), Tab. 36, fig. 12.¹

— *CYLINDRACEUS*, var. c. *Lamarck*. Animaux sans Vertèbres (1818).

LEPAS TINTINNABULUM. *Brocchi*. Conchologia Sub-Appen., t. ii, p. 597, (1814).

B. parietibus et basi, sed non radiis poris perforatis; testâ albo cum roseo aut obscure purpureo longitudinaliter pictâ, interdum purè albâ. Scuto longitudinaliter tenuiter striato: internè, adductoris cristâ admodum aut modicè prominente.

Parietes and basis, but not the radii, permeated by pores; shell longitudinally striped with white and pink, or dull purple; sometimes wholly white; scutum finely striated longitudinally; internally, adductor ridge very or moderately prominent.

Fossil in Coralline Crag, (Ramsholt and Sudbourne) rarely in the Red Crag (Sutton); Mus. S. Wood, Bowerbank, Lyell, J. de C. Sowerby, Tennant. Sub-Appenine formations, near Turin, Asti, and Colle in Tuscany, Mus. Greenough, &c. Tertiary bed, near Lisbon, Mus. D. Sharpe and Smith. Bordeaux (?) Mus. Lyell. Tertiary beds, Williamsburg; and Evergreen, Virginia, Mus. Lyell. Maryland, Mus. Krantz. Pleiocene formations² near Callao, Peru, Mus. Darwin.

Recent at Panama; Peru; S. Pedro, California; Philippine Arch.; Australia.

This species has caused me much trouble. It will be convenient first to make a few remarks on the recent specimens; I examined several from Panama and California, which, though differing greatly in colour, resembled each other in their scuta having the adductor ridge extremely prominent, and in having (Tab. I, fig. 4n) an almost tubular cavity for the attachment of the lateral depressor muscle,—characters which at first appeared of high specific value; but I soon found other specimens from Panama in which these peculiarities were barely developed. I then examined a single specimen from the Philippine Archipelago, resembling in external appearance one of the Panama varieties, but differing in the scuta being externally strongly denticulated in lines instead of being merely striated,—in the adductor ridge being far less prominent,—and in the spur of the tergum being broader and more truncated; I therefore considered this as a distinct species. I then examined a single white rugged specimen from the coast of Peru, which differed from the Philippine specimen in the shape of the well-defined denticulations on the scuta, and in some other trifling respects, and in the segments of the posterior cirri bearing a greater number of spines; with considerable doubt, I also named this as distinct. But when I came to

¹ I suspect that *B. pustularis*, *miser*, and *zonarius*, all figured by Münster, in his 'Beiträge,' b. iii, Tab. 6, may be this species.

² I procured this specimen from the Island of S. Lorenzo, off Callao; it was imbedded, together with seventeen species of recent shells and with human remains, at the height of eighty-five feet.

examine a large series of fossil specimens from the Coralline Crag of England, and others from northern Italy, from Portugal, and from the southern United States, I at once discovered that the form of the denticuli on the striæ of the scuta was quite a worthless character,—that in young specimens the scuta were simply striated,—that the prominence of the adductor scutorum ridge and the depth of the cavity for the lateral depressor muscle varied much (as in the case of the recent specimens), owing apparently to the varying thickness of the valve,—that in the terga the spur varied considerably in length and breadth, the latter character being in part determined by the varying extent to which the edges of the longitudinal furrow are folded in,—and lastly, that in young specimens the basal end of the spur is much more abruptly truncated than in the old. Hence I was led to throw the three recent forms, originally considered by me as specifically distinct, into one species; but I may repeat that this considerable variation in the prominence of the adductor ridge, and in the depth of the pit for the lateral depressor muscle—the pit in some cases becoming even tubular—is a very unusual circumstance.

With respect to the fossil specimens from the above stated distant localities, I consider them as belonging to one species, though they vary considerably in several points of structure. When compared with the recent specimens, they differ from them in often attaining a considerably larger size; in the parietes being generally longitudinally ribbed, as in the case of the Coralline Crag specimen (Tab. I, fig. 4*a*), and in the radii often having more oblique summits. Some of the specimens from the United States, have strong rugged, depressed shells, frequently resembling, to a curious degree, *Bal. porcatus*. On the other hand, considering the many points of identity between the fossil and the recent specimens, I have concluded, without much doubt, that they ought all to be classed together. In the Coralline Crag specimens, the spur of the tergum (Tab. I, fig. 4*g*) is unusually long and narrow; it is broader in the Italian specimens (4*o*), and either short (4*k*) or long in the United States specimens. The scuta of the Lisbon specimens are remarkable for the great prominence of the adductor ridge, and for the depth of the lateral depressor cavity, as in most, but not in all, of the Panama specimens. The opercular valves, however, of some of the specimens from all these several distant localities are identical with the recent ones from the coast of America. I have entered into the above particulars, on account of, in the first place, its offering an excellent example how hopeless it is in most cases to make out the species of this difficult genus without a large series of specimens; secondly, as showing how the characters alter with age; and thirdly, as a good instance of the amount of variation which seems especially to occur in most of the species which have very extensive ranges.

Some of the pink-striped Panama varieties, though having a somewhat different aspect, can be distinguished from certain varieties of *B. amphitrite* only by their scuta being longitudinally striated,—a character in this species variable in degree, and in most cases of very little value. Some of the other recent varieties, however, are sufficiently distinct from *B. amphitrite*; and the great fossil Coralline Crag specimens, which stand at the opposite

end of the series of varieties, with their ribbed walls, very oblique radii, and coarsely striated scuta, are extremely unlike *B. amphitrite*.

With respect to the nomenclature of the present species, I have little doubt that I have properly identified the Italian fossil specimens with *B. concavus* of Bronn, who has given a very good figure of this species in his 'Lethæa Geognostica;' but it must be confessed that the longitudinal striæ on the scuta are not there represented. Considering the large size and frequency of this species in Europe and in the United States, it has probably received several other names besides the two synonyms, quoted at the head of this description. I should add that the true *B. cylindraceus* (not *var. c*) of Lamarck, according to the plate given by Chenu in his 'Illust. Conch.' is the *B. psittacus* of South America. I have seen in collections specimens of *B. concavus* labelled as *B. tulipa* of Poli (*B. tulipiformis* of my Monograph),—a very natural mistake, without the opercular valves be carefully examined.

General Appearance.—Shell conical (fig. 4*a*), often steeply conical (fig. 4*c*), but sometimes depressed and smooth (fig. 4*d*); orifice generally rather small, varying from rhomboidal to trigonal, with the radii narrow, and generally in the fossil specimens very oblique; surface generally smooth, sometimes rugged, and in the Coralline Crag specimens commonly ribbed longitudinally, the ribs being narrow. In the recent specimens the colour is various, either dull reddish-purple with narrow nearly white, or wider dark longitudinal bands; or, again, pale rosy-pink with broad white bands; or lastly, wholly white. The radii are either darker or paler than the parietes. The opercular valves are either dark purple or nearly white. Pale pink and white stripes are visible on some of the Italian and Portuguese tertiary specimens; and in most of the fossils the sheath is tinged dull red.

Dimensions.—The largest actually recent specimen which I have seen, from the Philippine Archipelago, had a basal diameter of 1·2 of an inch; the Peruvian pleistocene specimen is 1·7 in diameter; specimens from the crag and from the Italian deposits, however, sometimes slightly exceed two inches in basal diameter, and three in height.

Scuta: these in young and moderately-sized specimens are striated longitudinally (fig. 4*l*), sometimes faintly, but generally plainly, causing the lines of growth to be beaded; but in large and half-grown specimens, the lines of growth are often extremely prominent, and being intersected by the radiating striæ, are converted into little teeth or denticuli. As the striæ often run in pairs, the little teeth frequently stand in pairs, or broader teeth have a little notch on their summits, bearing a minute tuft of spines. In very old and large specimens, the prominent lines of growth are generally simply intersected by deep and narrow radiating striæ (tab. I, fig. 4*p*). In one case, a single zone of growth in one valve was quite smooth, whilst the zones above and below were denticulated. The valve varies in thickness, which I think influences the prominence of the lines of growth and the depth of the striæ. These striæ often affect the internal surface (fig. 4*h*) of the basal margin, making it bluntly toothed. The articular ridge (fig. 4*n*), is rather small, and moderately reflexed. The adductor ridge (as already stated) varies remarkably; in most of the recent Panama specimens (fig. 4*n*),

and in the fossils from Portugal, it is extremely prominent, and extends down to near the basal margin; in other specimens it is but slightly prominent, as in those from the Crag (4*f*); it is short, but rather prominent in the specimens (4*h*) from Maryland; whereas it is very slightly prominent in the specimens from Virginia. The cavity for the lateral depressor, also, varies greatly; it is often, as in the recent specimens, bounded on the side towards the occludent margin by a very slight straight ridge, which occasionally folds a little over, making almost a tube; this, at first, I thought an excellent specific character, but far from this being the case, the cavity often becomes, in recent specimens as well as in the crag specimens (4*f*), wide, quite open, and shallow. The whole valve in the Crag specimens (fig. 4*e*) is apt to be more elongated than in the recent or Portuguese specimens (fig. 4*h*), and especially than in the Maryland (fig. 4*h*) specimens.

Terga very slightly beaked; the surface toward the carinal end of the valve, in some of the fossil specimens, is feebly striated longitudinally. There is either a slight depression (fig. 4*k*), or more commonly a deep longitudinal furrow (fig. 4*g*, 4*o*) with the edges folded in and touching each other, extending down the valve to the spur, and causing the latter to vary in width relatively to its length. When the furrow is closed in, the spur is about one fourth of the entire width of the valve, and has its lower end obliquely rounded, and stands at about its own width from the basi-scutal angle: when there is only a slight depression and no furrow (as is always the case with young specimens, and in the specimens (4*k*) from Maryland), the spur is broader, equalling one third of the width of the valve, with its lower end almost truncated, and standing at about half its own width from the basi-scutal angle. But the absolute length of the spur, also, varies considerably in the Coralline Crag specimens; it is often very long, (fig. 4*g*) compared to the whole valve. In many Italian specimens (4*o*) it is long and broad. The basal margin of the valve on the carinal side of the spur is sometimes slightly hollowed out; and when the longitudinal furrow is closed, this side slopes considerably towards the spur. Internally, the articular ridge and the crests for the tergal depressor muscles are moderately prominent.

Parietes, the longitudinal septa sometimes stand near each other, making the parietal pores small. The *radii* have oblique summits, but to a variable degree; their septa are unusually fine, and are denticulated on their lower sides; the interspaces are filled up solidly. The *alæ* have their summits very oblique, with their sutural edges nearly or quite smooth. In most of the fossil specimens (Tab. I, fig. 4*h*, *r*), and slightly in some of the recent specimens, the surface of the sheath presents an unusual character, in a narrow, longitudinal, slightly raised border, running along the sutures, on the rostral side of each suture.

Basis thin, porose; sometimes with an underlying cancellated layer.

All the recent specimens which I have seen, were, with one exception, attached to various shells and crabs, and to each other. The tertiary specimens are often congregated together into great masses. Including the recent and fossil specimens, this species encircles the globe. During the miocene period it seems to have been the commonest existing Sessile Cirripede; now, it does not appear to be common, excepting, perhaps, at Panama.

5. *BALANUS PORCATUS*. Tab. I, fig. 5a—5g.

BALANUS PORCATUS. *Emanuel da Costa*. Hist. Nat. Test. Brit., p. 249, (1778).

LEPAS BALANUS. *Linn.* Syst. Naturæ, (1767).

— — *Born.* Testacea Mus. Cæs. Desc., Tab. 1, fig. 4, (1780).

— — *Chemnitz.* Syst. Conch., 8 Band., Tab. 97, fig. 820, (1785).

BALANUS ARCTICA PATELLIFORMIS. *Ellis.* Philosoph. Transact., vol. 50, Tab. 34, fig. 18, (1758).

— *SULCATUS*. *Bruguère.* Encyclop. method., Tab. 164, fig. 1, (1789).

LEPAS COSTATA and *BALANUS*. *Donovan.* British Shells, 1802–1804, Tab. 30, fig. 1, 2.

LEPAS SCOTICA. *W. Wood.* General Conchology, Pl. 6, fig. 3, sed non *Lepas balanus*, Pl. 7, fig. 3, (1815).

BALANUS ANGULOSUS. *Lamarck* (1818), in Chenu, Illust. Conch., Tab. 11, fig. 11.

— *TESSELATUS*. *Sowerby* (!) Mineral Conchology, Tab. 84, (1818).

— *SCOTICUS*. *Brown.* Illust. Conch. Great Britain, Pl. 7, fig. 2, sed non Pl. 6, fig. 9 et 10 (1827): 2d edit., Pl. 53, fig. 1–3, 22, 23 et Pl. 54, fig. 1–3.

— *GENICULATUS*. *Conrad.* Journal Acad. Philadelphia, vol. vi, part 2, p. 265 (1830), Tab. 11, fig. 16.

— — *Aug. Gould* (!) Report on the Invertebrata of Massachusetts, fig. 9 (1841).

B. parietibus, sed non *basi*, *poris perforatis*; *testâ albâ*, *plerumque longitudinaliter acutè costatâ*; *radiorum marginibus superioribus pæne basi parallelis*: *scuto longitudinaliter striato*; *tergi apice producto*, *purpureo*.

Parietes, but not the basis, permeated by pores; shell white, generally sharply ribbed longitudinally; radii with their summits almost parallel to the basis. Scutum longitudinally striated; tergum with the apex produced and purple.

Fossil in the Glacial deposits of Scotland (Isle of Bute), of Uddevalla, and (Beaufort) Canada. In the Mammaliferous Crag (Bramerton, Thorpe) and Red Crag (Sutton); Mus. Lyell, J. de C. Sowerby, S. Wood, Bowerbank, &c.

Recent, England, Ireland, Scotland, Shetland Islands, Iceland, Davis's Straits, 66° 30' N.; Lancaster Sound, 74° 48' N. Maine and Massachusetts, United States. China (?) In deep water, commonly adherent on shells, crustacea, and rocks.

This species can be at once distinguished from all the foregoing by the basis being solid or not perforated by pores; and from all the following species, with the exception of *B. crenatus*, by the parietes having large square pores or tubes. From *B. crenatus*, this species can be distinguished by its longitudinally striated scuta, purple-beaked terga, and by the peculiar structure, immediately to be described, of its parietal pores; and in most cases even by its general aspect, larger size, and ribbed walls. When, however, *B. porcatus* and *crenatus* have grown together on the same irregular surface, for instance, on a Pecten, they sometimes resemble each other in a very deceptive manner. The opercular valves have not certainly been found fossil, but I have given drawings from recent specimens.

The parietes, (the basal margin of a small portion is represented at Tab. I, fig. 5*b*,) are perforated by large square longitudinal tubes : in the upper part these are filled up solidly without transverse septa ; the longitudinal septa between the tubes are finely denticulated at their bases, and the denticuli extend unusually close to the outer lamina. In very young specimens the inner lamina of the parietes is ribbed, in lines corresponding with the longitudinal septa, as in the case of other species of the genus ; but in medium and large-sized specimens, there are between such ribs from one to four smaller ribs, which do not correspond with any longitudinal septa ; these are finely denticulated at their bases, and may be considered as the representatives of longitudinal septa which have not been developed and reached the outer lamina. I have seen no other instance of this structure, namely, the presence of a greater number of ribs on the inner (upper in fig. 5*b*) lamina of the walls than there are longitudinal septa. As the parietes rest on the basis, the circumference of the latter becomes marked in a very peculiar manner (fig. 5*c*), by the basal edges of the parietal septa. Hence the basis of this species can be distinguished from that of every other sessile cirripede : its circumference is plainly impressed by the main parietal septa which connect the inner and outer laminæ of the walls ; and between these marks there are two or three smaller impressions of the so-called representative septa, which do not extend beyond the impression of the basal edge of the inner lamina. The upper surface of the middle part of the basis (more especially when slightly disintegrated) is faintly striated in radiating lines, of which the stronger lines are prolonged from the circumferential marks left by the main parietal septa, and the weaker lines from the marks left by the representative septa.

Dimensions.—The largest recent specimens which I have seen from great Britain or Ireland, have been 1·3 of an inch in basal diameter : in Mr. Cuming's collection, however, there is one much depressed specimen from the Shetland Islands, 2·1 in basal diameter ; a regularly conical specimen from the coast of Massachusetts attains a nearly equal diameter. But out of the glacial deposits in the Isle of Bute, several specimens have this same diameter, namely, two inches, and are even more steeply conical, being 1·85 in height ; some glacial specimens from Uddevalla and Canada, in Sir C. Lyell's collection, are 1·7 in basal diameter. Hence it appears, as we shall presently see is likewise the case with *B. crenatus* and *Hameri*, that northern specimens, and those from the United States and from the Glacial deposits, often exceed in dimensions those now living on the coasts of Great Britain and Ireland, or those found in the Crag.

This species is very common in the glacial deposits of Uddevalla, of Skien in Norway, and of Canada, and is associated with the same species, namely, *B. crenatus* and *Hameri*, as in the living state : I have seen, also, as just stated, specimens from the same formation in the Island of Bute, Scotland. I have examined numerous specimens from the Mammaliferous Crag, and a few from the Red Crag of England. I owe to the kindness of Mr. J. de C. Sowerby an inspection of the original specimens of *B. tessellatus* of the Mineral Conchology, which is certainly the present species.

6. *BALANUS CRENATUS*. Tab. I, fig. 6*a*—6*g*.

- B. CRENATUS*. *Bruguère*. Encyclop. Method. (des Vers) 1789.
LEPAS FOLIACEA, var. a. Spengler. Skrifter af Naturhist. Selskabet, b. i, 1790.
 — *BOREALIS. Donovan*. British Shells, Pl. 163, (1802–1804).
B. RUGOSUS. Pulteney (?) Catalogue of Shells of Dorsetshire, 1799.
 — *Montagu (?)* Test. Brit., 1803.
 — *Gould (!)* Report on Invertebrata of Massachusetts (1841), fig. 10.
B. GLACIALIS (?) J. E. Gray. Suppl. Parry's Voyage, 1819.
B. ELONGATUS (!) CLAVATUS (!), auctorum variorum.

B. parietibus, sed non basi poris perforatis; testá albá; radiorum marginibus superioribus obliquis, asperis, rectis; scuto sine adductoris cristá; tergi calcare rotundato.

Parietes but not basis permeated by pores; shell white; radii with their oblique summits rough and straight; scutum without an adductor ridge; tergum with the spur rounded.

Fossil in glacial deposits of Scandinavia and Canada, Mus. Lyell; in the mammaliferous and Red (Sutton) and Coralline Crags; Mus. S. Wood, J. de C. Sowerby, Bowerbank, &c. Miocene formation, Germany, Mus. Krantz.

Recent in Great Britain, Scandinavia, Arctic Regions as far as Lancaster Sound, in 74° 48' N.; Behring's Straits; United States; Mediterranean; West Indies; Cape of Good Hope. Generally attached to shells and crustacea in deep water.

Under the last species I have shown that the porose parietes, but solid basis, distinguish this species easily from all the others, with the exception of *B. porcatus*, from which it can readily be known by the characters of its opercular valves, as already thereunder stated. Judging by external appearances alone, which ought never to be trusted to in the identification of any sessile cirripede, this species might easily be confounded with *Bal. dolosus*, found fossil in the same deposits.

This species presents a great diversity of external aspect: I have had figured (Tab. I, fig. 6*a*) one of the commonest appearances presented by it; but frequently the shell is quite smooth and depressed, or extremely much elongated and cylindrical, or even club-shaped. The *basis* is generally thin and slightly furrowed in lines radiating from the centre, but it is not permeated by pores; when, however, in large and old specimens it becomes thicker, as in Tab. I, fig. 6*c*, its edge is very distinctly pitted by little hollows, which might sometimes be easily mistaken for the orifices of pores: the absence of pores is a very important character in the diagnosis of *B. crenatus*. The basis is less firmly attached to the supporting surface than is usual with most cirripedes, and consequently it often separates from it together with the parietes. With regard to the opercular valves (6*d*—6*g*) drawn from recent specimens, I need here only state that the most conspicuous

characters are the large articular ridge to the scutum, and the reflexed apices of all four valves, though this latter character is highly variable. I must refer to my Monograph on the Balanidæ for a full description of these valves.

The largest recent British specimen which I have seen was only .55 of an inch in basal diameter: specimens from Greenland and the northern United States, frequently attain a diameter of three-quarters of an inch, and I have seen one single somewhat distorted specimen actually 1.6 of an inch in basal diameter. Where individuals have grown crowded together, their length is often twice, and even occasionally thrice as great as their diameter; thus I have seen a recent Greenland specimen 1.6 of an inch in length, and only .75 in diameter. This species, in its recent state, as may be seen under the habitats, has an enormous range. I have felt myself unwillingly compelled to admit that it ranges from the Arctic Regions in 74° 48' N. to the Mediterranean, the West Indies, and Cape of Good Hope. That this species should live in the tropical seas is the more surprising, as the large size of the specimens in the northern seas and in the glacial deposits, might fairly have been supposed to have indicated special adaptation for a cold climate. This great geographical range, however, of the species accords with its range in time from the present day to the Coralline Crag period. The specimens from the glacial deposits which I have examined, chiefly in Sir C. Lyell's collection, are very fine and large, and appear, on an average, to attain as large or larger dimensions than the recent specimens from the United States; they are often associated, like the now living individuals, with *B. porcatus* and *Hameri*: they come from the well-known formation of Uddevalla, and from Canada. There are well-characterised specimens in the mammaliferous Crag, at Bramerton and near Norwich, in Sir C. Lyell's and Mr. Wood's collections, and from Sutton and other places in the Red Crag of the eastern shores of England: these specimens are not only smaller than the glacial, but than the recent English specimens; for the largest Crag specimens which I have seen had a basal diameter .5 of an inch, .3 to .4 being their ordinary size. The specimens which I have seen from the Coralline Crag, and some others sent me by Krantz from the miocene formation of Flonheim bei Abzei, in Germany, had not their opercular valves, yet I cannot doubt, considering how few species there are having porose walls and a solid basis, that I have rightly identified these specimens as belonging to *B. crenatus*.

7. *BALANUS HAMERI*, Tab. I, fig. 7a—7d., Tab. II, fig. 1a, 1b.

LEPAS HAMERI. *Ascanius*. *Icones rerum naturalium*, Tab. 10, 1767.

— TULIPA. *O. F. Müller*. *Prodromus. Zoolog. Dan.* 1776; sed non *L. tulipa*, in Poli, Test. ut Siciliæ; necnon *B. tulipa*, in Bruguière, *Encyclop. method.*; necnon *B. tulipa*, in Sowerby, *Genera of Shells*.

— TULIPA ALBA. *Chemnitz*. *Syst. Conch.*, Tab. 98, fig. 832.

— FOLIACEA. *Spengler*. *Skrivter af Naturhist. Selskabet*, 1 B. 1790.

BALANUS CANDIDUS. (Tab. emendata) *Brown*. Conch. Great Britain (1827), Tab. 6, figs. 9 and 10, and 2d edit. Tab. 54, figs. 9-12.

— TULIPA. *Lyell*.¹ In Phil. Transact., 1835, p. 37, Tab. 2, figs. 34-39.

B. nec parietibus, nec basi, nec radiis poris perforatis; testá albá; radiorum marginibus superioribus obliquis, lævibus, arcuatis; aciebus suturalibus lævibus; scuto angusto longitudinaliter, debiliter striato; tergi calcare angusto, rotundato.

Parietes, and basis, and radii not permeated by pores; shell white; radii with their oblique summits smooth and arched; sutural edges smooth; scutum narrow, feebly striated longitudinally; tergum with the spur narrow, rounded.

Fossil in Red Crag (Sutton), Mus. S. Wood Doubtfully in the Glacial beds of Scotland. In the Glacial deposits at Uddevalla, in Sweden; and Beaufort, Canada, Mus. Lyell. Banks of the Dwina, Russia, Mus. Murchison. Greenland, "in blue clay," according to Spengler.

Recent on the Coast of Yorkshire; Scotland; Galway, Ireland; Isle of Man, and Anglesey, twelve fathoms. Generally in deep water; not very common. George's Bank, Massachusetts, United States. Iceland, Finmark, and the Faroe Island, according to Spengler. Attached to crustacea, mollusca, stems of fuci, and stones; often associated with *B. porcatus* and *crenatus*.

I have seen, in Mr. Wood's collection, from the Red Crag, fine and perfectly preserved specimens of a rostrum, and of a lateral compartment. The latter was three inches in height, and, including the alæ, one inch in width. I have also seen a specimen said doubtfully to have come from the glacial beds of Scotland. As it is so very common in the deposits of this same age in other countries, no doubt it will hereafter be found more plentifully in Scotland, and probably in the mammaliferous Crag of England. *Balanus Hameri* is a very fine species; I have seen a recent specimen from the coast of Yorkshire, two inches in diameter, and one inch and three-quarters in height: another specimen was three inches in height. The specimens in the glacial deposits, seem to have acquired larger dimensions: a compartment from Uddevalla being nearly four inches in height. The white colour, smooth surface, and regularly arched radii, give to the shell a very elegant appearance, which has appropriately been compared to that of a white tulip. The diagnosis of this species is easy; the walls as well as the basis being solid or not porose, serve to distinguish it from all other forms except certain varieties of *Bal. unguiformis*, and by several minor characters, such as the finely striated and more elongated scuta, &c., *Bal. Hameri*, can be discriminated from *B. unguiformis*.

¹ Sir C. Lyell remarks that this is apparently the *B. Uddevallensis*, (Linn.), of Swedish lists of fossils. Prof. E. Forbes has shown ('Mem. Geolog. Survey of England,' vol. i, p. 364) how this name arose, from a short description, prior to the introduction of the binomial system, "*Lepas quæ Balanus Uddevallensis*," given by Linnæus in his *Wast-Gotha Resa*, in 1747.

For the reference to Ascanius' work, which is on the binomial system, and subsequent to the 10th edit. of Linnæus in 1758, I am greatly indebted to Mr. Sylvanus Hanley. Had it not been for this gentleman, I should have used Müller's name of *B. tulipa* as the first name.

In the recent condition, the compartments of the dead shell fall apart with singular facility; and Sir Charles Lyell has remarked ('Philosophical Transactions,' 1835, p. 37) that in the glacial deposits of Scandinavia, the shell is never found whole, but the separated compartments in abundance: it appears, also, that the basis likewise easily separates from its support. The extreme edge of the basis is finely crenated, and not pitted as in *Bal. crenatus*; the crenations or teeth are produced by the edge of the basis fitting in between the longitudinal septa on the internal surface of the parietes. There is one peculiarity in the alæ of this species in its recent state, which I have observed in no other species, and which can be distinguished in some of the fossil specimens, as in Tab. II, fig. 1*b*,—namely, the presence of an excessively fine linear furrow running along the sutural edge, a little towards the inner side, and filled (in the recent state) with a yellow ligamentous substance.

In regard to the opercular valves, (Tab. I, fig. 7*a*—7*d*, drawn from recent and glacial specimens,) I need here only mention, that in the *scuta*, their flatness, elongation, and delicate longitudinal striæ, are their chief characteristics. In very old and large specimens of the terga (as in the specimen, fig. 7*d*, figured from Uddevalla), the basal margin on the carinal side of the spur slopes down towards it in a remarkable manner.

8. *BALANUS BISULCATUS*, Tab. II, fig. 2*a*—2*h*.

BALANUS SULCATINUS (?) *Nyst*, apud D'Omalius (sine descript. aut tabulâ), Géologie de Belgique, 1853.¹

B. nec parietibus, nec radiis poris perforatis; basi poris magnis perforatâ; radiorum marginibus superioribus obliquis, lævibus; aciebus suturalibus lævibus; scuto angusto, sulcis longitudinalibus 2 ad 4; tergi calcare brevissimo dimidiâ valvæ latitudine.

Neither walls nor radii permeated by pores; basis permeated by large pores; radii with their upper margins oblique and smooth; sutural edges smooth; scutum narrow, with from two to four longitudinal furrows; tergum with the spur very short, broad as half the valve.

Var. plicatus (fig. 2*c*), *with the walls deeply folded; radii narrow, with their upper margins very oblique.*

Fossil in Coralline Crag; Ramsholt, Gedgrave, Sutton; Mus. S. Wood, Bowerbank, J. de C. Sowerby. Rauville, dans le Cotantin, Mus. G. B. Sowerby. *Var. plicatus*, Coralline Crag, Sutton, Mus. S. Wood, Bowerbank, Bolderberg, near Hasselt, Belgium, Mus. Bosquet.

¹ I am indebted to M. Bosquet for a specimen, bearing this name and reference, found in the 'Système Bolderien' of Dumont, (miocene according to Sir C. Lyell) at Bolderberg. The specimen consists of a rostrum, with a portion of the base attached; and as these parts are in some degree characteristic, I fully believe this specimen to be *B. bisulcatus*.

General Appearance.—Shell (fig. 2*a*) conical or tubulo-conical, often rather globose; walls frequently thin, either very smooth, or deeply plicated longitudinally: occasionally the same specimen is smooth in the upper part (fig. 2*b*), and strongly plicated in the lower. The radii in the large specimens are wide, and with their upper margins only slightly oblique; in the smaller they are narrower, and much more oblique; but in each case their upper margins are smooth and slightly bowed. Colour apparently originally nearly white, but with the alæ generally, in the smaller specimens, clouded with a dark tint: the radii are usually striped feebly in longitudinal lines. Basal diameter of largest specimen .8 of an inch; but this seems to have been an unusual size.

Scuta: (fig. 2*e*) narrow, with the basal margin forming an unusually small angle with the occludent margin; surface slightly convex, with lines of growth approximate, moderately prominent; on the tergal half of the valve, two distinct rather broad furrows, with sometimes a third, and even a fourth, nearer to the occludent margin, extend from the apex down the valve, and give it a very peculiar appearance: the furrows near the tergal margin are the deepest. Internally (fig. 2*g*), the upper part of the valve is roughened with small points: the articular furrow is unusually wide: the articular ridge is very prominent and but little reflexed, with the lower end almost abruptly cut off: the adductor ridge is prominent, but short: there are small deepish pits for the rostral and lateral depressores.

Terga (fig. 2*f*), broad, flat, with a slight narrow prominent rim along the scutal margin, which margin is slightly bowed. The basal margin on the carinal side of the spur slopes so gradually towards the spur, that the latter is barely distinct, and is very short, not depending nearly half its own width beneath the basi-scutal angle: the spur, also, is broad, namely, measured across the upper part, as broad as half the valve; its basal end is obliquely rounded off on the carinal side; it is placed close to basi-scutal angle. The carinal margin of the valve is just perceptibly bowed, and is formed by rectangularly upturned lines of growth. Internally (fig. 2*h*), the upper part of the valve is rough; the articular ridge is prominent; the crests for the tergal depressores muscles are moderately well-developed.

Parietes, not porose; internally, the ribs are smooth, with their basal edges very finely or barely denticulated. The *radii* (as already stated) are of variable breadth; they have their upper margins either very slightly or highly oblique, but always smooth and rounded: their sutural edges are quite smooth, or sometimes, with a strong lens, traces of transverse striæ, representing septa, can just be discovered. The *alæ* have their upper margins very oblique; their sutural edges are, in the large specimens, quite smooth; in the younger ones, plainly crenated; the recipient furrow being clearly marked by the teeth. *Basis* plainly porose.

Varieties.—It is certain (fig. 2*b*) that there are longitudinally plicated specimens of this species, and that the obliquity of the upper margins of the radii also varies a little; nevertheless some of the deeply plicated specimens (fig. 2*c*) undoubtedly have a very

different aspect from the ordinary varieties, and do really differ in the sutural edges of the alæ being crenated, and in the greater narrowness and obliquity of the radii; but these points are all commonly variable. I have not seen any large specimens of the variety (fig. 2c), *plicatus*, so as to compare them with the large specimens of the normal form, yet I can hardly entertain any doubt, considering their agreement in so many important points, that I have rightly treated these forms as mere varieties; it is unfortunate that none of the specimens of the *var. plicatus* seen by me have had opercular valves, as their presence would have removed all shadow of doubt. I have given a drawing, enlarged seven times, of some very young shells (fig. 2d), adhering in numbers on *Pecten Gerardii*, which I believe belong to the plicated variety of our present species, but which are much too young to be identified with certainty.

Affinities: this is a strongly characterised species, and nearly allied only to the following species, *B. dolosus*. The furrows on the scuta in some degree resemble those on the recent *B. lævis*, but there is no alliance with that species. It is certain that amongst recent species, the chief affinity is with *B. Hameri* and *amaryllis*.

9. *BALANUS DOLOSUS*. Tab. II, fig. 3a—3d.

B. nec parietibus, nec radiis poris perforatis; basi poris magnis perforatâ, radiorum marginibus superioribus obliquis, lævibus; aciebus suturalibus item lævibus; tergi calcare non admodum brevi, $\frac{1}{3}$ valvæ latitudine.

Neither walls nor radii permeated by pores; basis permeated by large pores; radii with their upper margins oblique and smooth; sutural edges smooth; tergum with the spur not very short, broad as one third of valve.

Fossil in Red (Sutton) and Mammaliferous Crag; Mus. S. Wood, Bowerbank, Lyell, J. de C. Sowerby, Henslow, &c. Mammaliferous Crag, Postwick, near Norwich, Mus. Lyell.

This species so closely resembles *B. bisulcatus*, both externally and in all the essential characters of the parietes, radii, and basis, that it is quite superfluous to describe again these parts. The specific characters are derived from the opercular valves, which present well defined distinctions, found by me constant in several specimens of both species. *B. dolosus*, like *B. bisulcatus*, has quite smooth and deeply plicated varieties, often adhering to the same univalve. The ribs on the inner surfaces of the parietes are remarkably prominent, as shown in the drawing (fig. 3a) of the inside of the rostrum. I think the upper margins of the radii are in this species rather more oblique than in *B. bisulcatus*. The sutural edges of the radii are marked by the finest striæ, representing septa. The sutural edges of the alæ are generally distinctly crenated. The basis is often slightly cup-formed, and very plainly porose (fig. 3b): its upper surface is marked by

radiating ridges: the septa between the radiating pores are themselves often in part porose, as was plainly the case in the specimen (fig. 3*b*) engraved. The orifice of the shell is large and elongated in its rostro-carinal axis, especially in young specimens. The basal diameter of the largest specimen is $\cdot 4$ of an inch.

The *scuta* (fig. 3*c*) have no trace of the two or three longitudinal furrows so conspicuous on these valves in *B. bisulcatus*, and which, in that species, run down to the basal margin from the apex of the valve, this fact showing that the furrows occur in quite young individuals. The whole valve is not quite so narrow as in *B. bisulcatus*, but otherwise agrees with it in shape: internally, there is hardly any difference; but the articular furrow is not quite so wide: the articular ridge is very prominent, and abruptly truncated at its lower end: the adductor ridge is also prominent; it here runs a little higher up the valve than in *B. bisulcatus*. The *tergum* (fig. 3*d*) differs more in the two species: the spur is not so broad; measured in its upper part, it is only about one third of the entire width of the valve, instead of being half as wide as the valve: it is considerably longer, depending beneath the basi-scutal angle more than half its own width: the basal margin of the valve on the carinal side, does not slope so gradually into the spur; the occludent and carinal margins are slightly arched, as in *B. bisulcatus*. Internally, the surface is rough, the articular ridge is prominent, and the crests for the tergal depressores are well developed,—all as in *B. bisulcatus*. It is remarkable how generally the opercular valves have been preserved in this species in its fossil condition, as compared with most other species of the genus.

It is not easy to distinguish, by external characters, the rugged varieties of this species from *B. crenatus*; indeed, the only difference is that the furrows receiving the edges of the radii, generally, exhibit in *B. crenatus* slight impressions of the septa, which are entirely absent in *B. dolosus*. By internal characters, such as the non-porose parietes, and porose basis, our present species widely differs from *B. crenatus*.

10. BALANUS UNGUIFORMIS. Tab. II, fig. 4*a*—4*f*.

BALANUS UNGUIFORMIS. *J. de C. Sowerby* (!) Mineral Conchology (sine descriptione), Tab. 648, fig. 1, (Jan. 1846.)

— ERISMA. *J. de C. Sowerby* (!) *Ib.*, fig. 2.

— PERPLEXUS. *Nyst*, apud D'Omalius (sine descript. vel Tab.), Géologie de la Belgique, 1853.¹

B. parietibus tenuibus, interdum poris perforatis: radiis sine poris, marginibus superioribus obliquis; aciebus suturalibus tenuissimè crenatis: basi sine poris: tergi calcare angusto, obtuso.

¹ I am much indebted to M. Bosquet for specimens bearing this title, from Klein Spauwen, which certainly appear to me, as far as can be judged by the separated compartments, without the opercular valves, to belong to our present species.

Parietes thin, sometimes permeated by pores; radii without pores, with their upper margins oblique; sutural edges very finely crenated; basis without pores. Tergum with the spur narrow, bluntly pointed.

Var. erisma (fig. 4*b*), with the walls longitudinally folded or ribbed.

Fossil in the Eocene formations, Isle of Wight, Colwell Bay; Hordwell; Barton, (Chama Bed); Headon; Bembridge; Bergh, near Klein Spauwen, Belgium (?). Attached to various shells and wood. Mus J. de C. Sowerby, E. Forbes, F. Edwards, Charlsworth, T. Wright, Bowerbank, Tennant, Bosquet.

This species, the most ancient one as yet well known in the genus, presents to the systematist a most unfortunate peculiarity, in the parietes being almost as often as not permeated by small pores: I have seen no other instance, except to a limited degree in the recent *B. glandula*, of this character being variable, and hence it must be still considered of high classificatory value, in so varying a genus as *Balanus*. Owing to the kindness of Mr. F. Edwards, I have seen the original specimens, excellently figured by Mr. J. de C. Sowerby, in the 'Mineral Conchology,' under the names of *B. unguiformis* and *erisma*, between which I can perceive no difference, excepting that the walls in the latter are longitudinally folded,—a character we know to be variable in many species. In both varieties, the parietes are sometimes porose and sometimes solid. The smaller specimens, however, figured in the 'Mineral Conchology' to the right hand of the Plate, may possibly be a distinct species, as I infer from the narrowness of their radii. This species is intimately allied to *B. varians*, a fossil from the ancient tertiary plains of Patagonia. It is also allied to the recent *B. crenatus* and *glandula*.

General appearance.—Shell (fig. 4*a*), tubulo-conical, sometimes even sub-cylindrical: surface either very smooth, or slightly folded, or deeply folded so as be strongly ribbed longitudinally: orifice rather large, rhomboidal, narrow at the carinal end, toothed, but not deeply: walls rather thin and fragile: radii of moderate width, with their summits oblique, not quite smooth. Basal diameter of largest specimen about three quarters of an inch.

Scuta (fig. 4*c*), with the external surface smooth: there is a trace of a furrow running down the valve from the apex, near to the occludent margin, and this is only worth mentioning from the analogous furrows in *B. biscalatus*. Internally (fig. 4*e*), the upper surface of the valve is roughened: the articular ridge is very prominent, and slightly reflexed: there is no distinct adductor ridge; there is a slight but variable depression for the lateral depressor. *Tergum* (fig. 4*d*), with the longitudinal furrow shallow; spur moderately long, about one fourth or one fifth of the width of the valve; placed at about its own width from the basi-scutal angle; basal end bluntly pointed; the basal margin on the opposite sides of the spur forms a nearly straight line; the carinal margin has an extremely narrow border formed by upturned lines of growth. Internally (fig. 4*f*), the surface is roughened with little points: the articular ridge is prominent: the crests for the tergal depressores moderately prominent.

Parietes: the longitudinal ribs on the internal surface are either feebly, or, in the lower part, strongly developed; their basal ends are only just perceptibly denticulated. As already stated, in about half the specimens, there were no traces of parietal pores; in the other half there were either distinct or obscure pores; the pores are circular, generally of unequal sizes, and never large; in the same individual they would sometimes be almost wholly absent in some of the compartments, and quite plain in the other compartments. The *radii* are either moderately wide or rather narrow, and have their upper margins very oblique, and not distinctly arched, and not quite smooth: their sutural edges are very finely crenated, the teeth or septa not being denticulated. The upper margins of the *alæ* are rather less oblique than those of the radii: their sutural edges are barely crenated. The *basis* is thin, and without any trace of pores; the upper surface is sometimes furrowed in radiating lines.

11. BALANUS INCLUSUS. Tab. II, fig. 5a—5g.

B. nec parietibus, nec radiis poris perforatis; basi poris perforatá: testá rufo-fuscá: radiis latis, marginibus superioribus aut non obliquis aut modicè; aciebus suturalibus cum septis planè denticulatis: scuto sine adductoris cristá: tergi calcare subangusto.

Neither walls nor radii permeated by pores; basis porose; shell reddish-brown; radii broad, with their upper margins not oblique, or only moderately oblique; sutural edges with plainly denticulated septa: scutum without an adductor ridge; tergum with the spur rather narrow.

Var. (a) (fig. 5c, 5d), with the shell elongated in its rostro-carinal axis; basis narrow, clasping the stem of a zoophyte; lateral compartments much broader than the almost linear rostrum, carina, and carino-lateral compartments.

Var. (b), with rough longitudinally folded walls, and with the summits of the radii forming an angle of about 45° with the basis.

Fossil in Coralline Crag; Sutton and Gedgrave; attached to foliaceous Bryozoa; Mus. S. Wood, Bowerbank. *Var. a*, Coralline Crag, Sutton, attached to cylindrical branches of corals; Mus. S. Wood, Bowerbank. *Var. b*, attached to shells, Osnabruck, Hanover, Mus. Lyell; Bunde, Westphalia, Mus. Krantz.

My materials consist of a beautiful series of specimens in Messrs. Wood and Bowerbank's collections; but unfortunately only a single young specimen had its opercular valves preserved. Not one specimen of the very curious variety (*a*) had opercular valves, yet I cannot feel any doubt about its being only a variety, caused by its attachment to a thin cylindrical branch of a coral, instead of to a foliaceous Bryozoon; it will, however, be convenient to give a separate description of this very remarkable form. With respect to var. (*b*), both sets of specimens came to me from the Continent, with the name of

B. stellaris, of Bronn; but as Bronn distinctly states, that in his species the parietes are porose, and as such is not here the case, this cannot possibly be that species: these specimens did not possess their opercular valves, and therefore cannot be identified with certainty.

General Appearance.—Shell conical (fig. 5*a*, 5*b*), with the orifice rather large, and rhomboidal. The surface is very smooth, except in var. (*b*) from the Continent, in which it is rugged and longitudinally folded. The colour is ochreous-brown (chiefly no doubt derived from the imbedding substance), tinged with red. The radii often have a much darker and more distinct red tint; they are sometimes longitudinally striped with dirty white. The radii are broad, with their summits straight, and very slightly oblique; in var. *b*, however, they slope at an angle of about 45°. Basal diameter of largest specimens .6 of an inch; but this is an unusual size.

Scuta, with the growth ridges little prominent. Internally (fig. 5*f*, from a young individual) the articular ridge is moderately prominent, with its lower end very obliquely rounded off; there is no adductor ridge; there is a minute pit for the lateral depressor muscle. *Terga*, with a slight longitudinal depression extending down to the spur; spur short, with its lower end almost square or truncated, about one fourth of width of valve, and placed at about half its own width from the basi-scutal angle. Internally (fig. 5*g*), the articular ridge is prominent; the crests for the tergal depressores are feebly developed.

Parietes, moderately thick and generally strongly ribbed internally, without parietal pores. *Radii*, wide, with their upper margins straight, not smooth or rounded, and very slightly (or, in var. *b*, moderately) oblique; their sutural edges have well-developed septa, which are denticulated: the interspaces between the septa are filled up solidly. The *alæ* have their upper margins oblique: they are only slightly, and sometimes not at all, added to above the level of the opercular membrane: their sutural edges are smooth. The *basis* is thin, but plainly porose.

Var. (a) (fig. 5*c*, 5*d*).—With respect to this remarkable variety, any one would at first think it specifically distinct. The shell is much compressed, or elongated in the rostro-carinal axis, sometimes to a great degree; I have seen a specimen .25 of an inch in this axis, and only .1 in its broadest part; but this is a very unusual degree of elongation. The most remarkable character is the extraordinary narrowness of the carina, of the carino-lateral compartments, and of the rostrum, compared with the great breadth, especially along the basal margin (fig. 5*d*), of the lateral compartments. The radii are of unusual breadth. The tips of the rostrum and of the lateral compartments are a little arched in, tending to make the shell somewhat globular. The true basis is extremely narrow (fig. 5*d*): it is deeply grooved, from clasping the thin, cylindrical stem of the coral to which it has adhered; and I have seen specimens in which the opposite edges of the groove had met, a tube having been thus actually formed. From the grooved basis, and from the elongation of the shell in the rostro-carinal axis, this variety presents so close a general resemblance to *Balanus calceolus*, and its allies, that I have seen it in a collection arranged on the same tablet with

a fossil specimen of *B. calceolus*. Notwithstanding the above several strongly-marked characters, by which this variety differs from the ordinary form, there is a resemblance in colour and aspect, which, though difficult to be described, made me from the first suspect that the two were specifically identical. In no point of real structure is there any difference, excepting that, perhaps, the pores in the basis are here rather smaller; but this might arise from the little development of the peculiar basis. Having come to this conclusion, I was interested by finding a specimen (fig. 5e) in Mr. Wood's collection, which had originally fixed itself (judging from the form of the basis) on a thick cylindrical stem, but which had subsequently grown on to an adjoining flat surface; consequently, one side of the shell presented all the peculiar characters of the present variety, but not strongly pronounced, whereas the other side, at the rostral end, was undistinguishable from the ordinary form. The unequal development of the rostrum on the two sides was very striking, and clearly showed how great an effect could be produced by the nature of the surface of attachment.

This singular variety cannot be considered accidental, in the sense in which this term may be applied in some cases: the pupa evidently fixes itself intentionally, in a certain definite position, on the branch of the coral (when a branch is chosen), exactly as in the case of *Balanus calceolus*, or *Scapellum vulgare*,—species which always live attached to branches. But when other Balani occasionally fix themselves on branched corals, their position seems to be accidental and unsymmetrical; thus among the symmetrically elongated specimens of the present species, I found one specimen of *Balanus bisulcatus*, which had evidently been attached in an almost transverse position to a branch, and had thus become much distorted; so, again, I have seen specimens of the recent *B. amaryllis* attached irregularly to a Gorgonia, in the midst of the symmetrically elongated shells of *Balanus navicula*, an ally of *B. calceolus*.

This variety does not seem to attain so large a size as the ordinary form.

Affinities.—This species is allied to *B. unguiformis* and *B. varians*, but is perhaps more nearly related to the recent *B. allium*, an inhabitant of the Barrier Reef of Australia. The longitudinally folded variety (*b*) can hardly be distinguished by external aspect, or even by the opercular valves, from *B. crenatus*; but when the shell is disarticulated, the porose walls and non-porose basis of *B. crenatus*, allow of no mistake in the diagnosis of the two species.

Sub-Genus—ACASTA.

ACASTA. *Leach*. *Journal de Physique*, tom. lxxxv, 1817.

Valvæ testæ 6; parietes et basis non porosa; basis calcarea, cyathiformis, non elongata. Valvæ operculares inter se articulatae, subtriangulares. Spongiis, aut rarò Isidis cortici, affixa.

Compartments six; parietes and basis non-porose: basis calcareous, cup-formed, not

elongated, attached to Sponges, or rarely to the bark of Isis: scutum and tergum articulated together, subtriangular.

Under the last genus, I have made a few remarks on the close affinities of this sub-genus to Balanus, and have given my reasons for retaining it, so that I need not here repeat them.

ACASTA UNDULATA. Tab. II, fig. 6*a*—6*f*.

A. testá, ad speciem, ut in "A. spongites," sed majore: scuto externe striis longitudinalibus, sæpe binis, signato, sulcis intermediis latioribus: tergi calcare, pæne $\frac{1}{2}$ valvæ latitudine.

Shell, apparently, as in *A. spongites*, but larger: scutum marked by longitudinal ridges, often in pairs, with the intermediate furrows rather wide: spur of tergum nearly half as wide as valve.

Fossil in Coralline Crag (Sutton), Mus. S. Wood, Bowerbank.

I owe to Mr. Wood the inspection of a fine suite of valves, which, though separate, I have no reason to doubt have all been rightly attributed to the same species. Owing to the shell never having been found entire, its general shape is not known, and, what is of more consequence, the relative proportional width of the parietes of the carino-lateral compartment is unknown. I have (but with doubt) given it a distinct specific name, owing to the peculiar character of the furrows on the scuta, and to the large size of the whole shell. In its other characters it comes nearest to *A. spongites*, excepting in the spur of the tergum, which resembles that of *A. sulcata*.

The external surfaces of the compartments appear generally to have been smooth; but in several specimens they are studded with the sharp shelly points so common in the genus. A rostrum (Tab. II, fig. 6*a*), and lateral compartment (fig. 6*b*), have been figured. The radii are not wide. The basis (fig. 6*c*) is cup-formed: its edge is either quite smooth, or is very finely crenated. The basis is sometimes quite irregularly perforated, as in the case of several recent species, by numerous minute orifices, which, when the animal was alive, no doubt were covered by membrane. Internally the parietes are feebly ribbed, as in *A. spongites*. Judging from the dimensions of the separated valves, this species must have equalled and perhaps exceeded in size the largest living species, namely, *A. glans*, from Australia. Hence we may infer, that the basal diameter probably exceeded $\cdot 55$ of an inch: I may add, that the largest European specimens of *A. spongites*, from Naples and Portugal, are only $\cdot 3$ of an inch in basal diameter.

Scuta (fig. 6*e*).—These seem to resemble the scuta of *A. spongites* in all respects, except

in the external longitudinal ridges standing much further apart, and, consequently, in the furrows being much wider: each ridge is generally double. Although there is a good deal of variability in the character of these ridges in *A. undulata*, and likewise in *A. spongites*, I have not seen any form intermediate between them. It must, however, be confessed, that this is an extremely variable character in many sessile cirripedes. Internally the scutum (fig. 6*d*) is chiefly characterised by the absence of characters, that is, by the slightness of the pits for the muscles, and the little prominence of the articular ridge. In the *tergum* (fig. 6*f*), the spur is about half the width of the whole valve, and therefore rather wider than in *A. spongites*.

Genus—PYRGOMA.

- PYRGOMA. *Leach*. Journal de Physique, tom. 85, 1817.
 BOSCIA. *Ferussac*. Dict. Classique d'Hist. Naturelle, 1822.
 SAVIGNIUM. *Leach*. Zoological Journal, vol. ii, July, 1825.
 MEGATREMA. *Ib.* *Ib.*
 ADNA. *Ib.* *Ib.*
 DARACIA. *J. E. Gray*. Annals of Phil. (new series), August, 1825.
 CREUSIA. *De Blainville*. Dict. Sc. Nat., Pl. 116, 1816–30.
 NOBIA. *G. B. Sowerby, junr.* Conchological Manual,¹ 1839.

Valvæ testæ in unam confluentæ: basis cyathiformis aut subcylindrica, coraliis affixæ: valvæ operculares inter se articulatæ.

Shell formed of a single piece: basis cup-formed, or subcylindrical, attached to corals: scutum and tergum articulated together.

This genus can at once be recognised by the shell consisting of a single piece without sutures, whether viewed externally or internally, and by the cup-shaped basis, attached and often imbedded in corals. The one species, *P. Anglicum*, found both recent and fossil, together with a closely allied recent species, *P. Stokesii*, in all the characters derived from the opercular valves, closely resemble *Balanus* and other ordinary forms, and for this very reason they have some slight claims to be generically separated from the other species of *Pyrgoma*; for in these latter, the opercular valves seem to have broken loose from all law, presenting a greater diversity in character than do all the other species of *Balaninæ* and *Chthamalinæ* taken together.

¹ The name, *Nobia*, is given in this work on the authority of *Leach*, but this must be a mistake, probably caused by some MS. name, (that fertile source of error in nomenclature), having been used.

PYRGOMA ANGLICUM. Tab. II, fig. 7a—7c.

PYRGOMA ANGLICA. *G. B. Sowerby*. Genera of Recent and Fossil Shells, fig. 7, No. 18, Sept. 1823 (sine descript.).

MEGATREMA (ADNA) ANGLICA. *J. E. Gray*. Annals of Philosoph. (new series), vol. x, Aug. 1825.

PYRGOMA SULCATUM. *Philippi*. Enumeratio Molluscorum Siciliae, Tab. 12, fig. 24, (1836).

— ANGLICA. *Brown*. Illustrations of Conchology, (2d edit., 1844), Tab. 53, fig. 27—29.

P. testâ abruptè conicâ, purpureo-rubrá; orificio ovato, angusto; basi porosâ, plerumque è corallo exserta: scuto et tergo subtriangularibus.

Shell steeply conical, purplish red: orifice oval, narrow: basis permeated by pores, generally exserted out of the coral: scutum and tergum sub-triangular.

Fossil in the Coralline Crag (Ramsholt) Mus. S. Wood.

Recent on the south coast of England and of Ireland, (12 to 45 fathoms, Forbes and MacAndrew); Sicily; Madeira; St. Jago, Cape de Verdè Islands; generally attached to the edge of the cup of a Caryophyllia, in deep water, but at St. Jago within the tidal limits.

I have considered this fossil as identical with the recent species, but, as may be seen from the following description, it presents several slight differences; yet they are such that I dare not found a new species on only a few specimens thus characterised.

The shell is steeply conical, slightly compressed, with the lower part having rounded, approximate, radiating ribs; these ribs seem to be more prominent in the fossil than in the recent specimens. Colour dull purplish-red. Orifice oval, small, and narrow. The basis is not deeply conical, and occasionally is even flat: in the Crag specimens it is almost wholly imbedded in the coral to which it is attached; but in recent specimens it is generally exserted. Externally the basis is furnished with ribs corresponding with those on the shell. The largest recent specimens which I have seen, from St. Jago, was .22 of an inch in basal diameter; but some few of the British specimens are nearly as large, and one of the fossils from the Coralline Crag a very little larger.

The *scuta* and *terga* are of the ordinary shape of these valves in *Balanus* and its allies. *Scutum* (fig. 7b) triangular, with the basal margin a little curved and protuberant; adductor and articular ridges distinct from each other, moderately prominent; there is a small hollow for the lateral depressor muscle: in the fossils, the adductor ridge (as figured) is more distinct from the articular ridge, and consequently the cavity for the lateral depressor muscle is wider and less deep than in recent specimens. *Tergum*, I have not seen a fossil specimen, but have figured a recent valve (7c); it is triangular, with the spur rather narrow, moderately long, placed near, but not confluent with, the basi-scutal angle of the

valve. The basal margin forms an angle rather above a right angle with the spur. Internally the articular ridge and crests for the depressor muscles, feebly developed.

Internal Structure of the Shell and Basis.—Internally, the shell is ribbed, more or less prominently. The lower edge of the sheath, which is reddish, and extends far down the walls, seems always to project freely. In several specimens there were on each side, at the carinal end of the shell, a trace apparently of a suture, which could be perceived only on the sheath. The basis appears always to be permeated by minute tubes or pores, though these are sometimes rather difficult to be seen.

Michelotti, in the 'Bulletin Soc. Géolog.' Tom. 10, p. 141, has named, but not described, a species, viz., *Pyrgoma undata*, from the northern Italian Tertiary Strata.

Genus—CORONULA.

CORONULA. *Lanarch.* Annales du Muséum, tom. i, (1802).

DIADEMA. *Schumacher.* Essai d'un Nouveau Syst., &c., 1817.

CETOPIRUS (SED NON CORONULA). *Ranzani.* Memoire di Storia Naturale, (1820).

POLYLEPAS. *J. E. Gray, (Klein).* Annals of Philosophy, (new series), vol. 10, 1825.

Valvæ tastæ 6, æquali latitudine; parietes tenues, profundè plicati, plicis cavitates infra solùm apertas efficientibus; valvæ operculares non inter se articulatæ, orificio testæ multo minores: basis membranacea. Cetaceis affixa.

Compartments six, of equal sizes: walls thin, deeply folded, with the folds forming cavities, open only on the under side of the shell: opercular valves much smaller than the orifice of the shell; when both present not articulated together: basis membranous. Attached to Cetaceans.

The structure of the shell of *Coronula* is complicated, and has been generally quite misunderstood. Without a long description and several figures it would be impossible to give a true idea of its singular structure; but, in order to make the following description at all intelligible, I must make a few remarks. The wall of each compartment, and therefore of the whole shell, is extremely thin; but strength is gained by its being folded in a very complicated manner, as may be seen in the rostral compartment, Tab. II, fig. 8b, by tracing the wall *e* to *e'*, to *e''*; the folds at their outer ends are elongated into transverse loops, the extremities of which touch each other; consequently, what appears to be the outside of the shell consists only of a portion of the wall, namely, the outsides of the transverse circumferential loops, together with the radii. These loops appear externally like much flattened longitudinal broad ribs. On the other hand, the inside of the shell, in which the body is lodged, consists of the inner ends of the folded walls, lined by the sheath, and by the alæ. The basal edges of the folded walls, in the line of the ray of the circular shell, are oblique; the outer ends, or transverse circumferential loops, having grown downwards at a greater rate than the inner ends. Between each fold of the walls, there is a flattened

cavity, open at the bottom of the shell, and running up to the apex : these cavities are quite external to the cirripede, and are occupied by the epidermis of the whale to which the Coronula is attached : homologically they are only deep longitudinal furrows, and they would still have been furrows, had not the transversely elongated ends of the folds, *i. e.*, the circumferential loops, in all cases, after early growth, grown into close contact. The ends of these loops are generally locked together by rows of minute teeth. In all the species, when young, the wall of each compartment is folded three times, and therefore the whole shell has eighteen folds.

The radii, normally, are only part of the wall, modified by growing against an opposed compartment ; and hence the radius in Coronula would have been extremely thin, like the wall, and the sutures between the six compartments excessively weak, had not the radii been specially thickened by numerous sinuous denticulated plates, springing from the inner lamina of the true radius, and running downwards, attached to the folded wall of the compartment to which the radius belongs, and with their free edges pressed against the folded wall of the opposed compartment. Hence the radii may be said to be compound. For the sake of strengthening the sutures, the alæ, also, are very unusually thick : but, notwithstanding their thickness and the thickness of the compound radii, owing to the depth of the folds of wall, they are separated from each other by a considerable space, and the alæ, instead of resting in chief part, as they should do, on the inner lamina of the radius, have to rest on special plates, developed apparently from the sheath. In the upper part of the shell, between the special plates on which the alæ rest, and the compound radii, there are in two of the three recent species, open chambers, six in number, occupied by the ovarian cæca ; but in the fossil *C. barbara* these chambers are almost filled up solidly by shell. I hope that the terms used in the following description may be now in some partial degree rendered intelligible.

CORONULA BARBARA. Tab. II, fig. 8a—8e.

CORONULITES DIADEMA (?) *Parkinson*. *Organic Remains* (1811), vol. iii, p. 240, pl. 16, fig. 19.

C. testá (*probabiliter*) *coroniformi*, *costis longitudinalibus convexis*, *aciebus earum crenatis*, *superficie interná et externá cristis transversis asperá* ; *radiis modicè crassis* ; *spatiis inter radios et alas solidè impleto*.

Shell (probably) crown-shaped, with longitudinal convex ribs, having their edges crenated, and their surfaces rugged, both externally and internally, with transverse ridges : radii moderately thick ; the space between the radii and the alæ solidly filled up.

Fossil in Red Crag, (Bawdsey and Sutton) ; Mus. S. Wood and Geological Society.

This species, though closely allied to *C. diadema* and easily confounded with it, I have no doubt is distinct. I owe to the kindness of the Rev. Mr. Image an examination of the original specimen figured by Parkinson; and in Mr. Stutchbury's collection there is a similar and more perfect specimen; both of these resemble *C. diadema* in general form, but have been too much worn to be positively identified. The following description is drawn up from some compartments collected by Mr. Searles Wood, belonging certainly to three and probably to four individuals, one of which was young; as these specimens agree in all essential respects, I feel pretty confident that the characters, by which the present species differ from *C. diadema*, are of specific value.

Structure of Shell.—The longitudinal ribs on each compartment (*i. e.* the circumferential transverse loops), are convex and prominent, as in *C. diadema*, but they are crossed by more prominent ridges of growth (fig. 8*a*, 8*e*) than even in the roughest varieties of that species, so that the surface of the shell is more rugged. In the three recent species—viz., *C. diadema*, *balænaris*, and *reginæ*, the surface of the wall all round the cavities occupied by the whale's skin, is striated only by very fine longitudinal lines; but here, the outer portion, or that (fig. 8*d*) formed by the transverse loops, is crossed by transverse ridges of growth, like, but less prominent, than those on the external surface of the shell. The minute teeth, along the lines of junction between the transverse loops, are here less regular, and can hardly be said to exist; for the two edges are locked together by what may be more strictly called minute zig-zag ridges (fig. 8*d*, 8*e*), than teeth. The exact number of the circumferential plications (fig. 8*b*) in the wall of the shell is variable, in the same manner as in the three recent species. In the rostrum which has been figured (8*b*, enlarged twice its natural size), there is a peculiarity, probably accidental, which I have seen in no other specimen—namely, that one of the transverse circumferential loops at the end of one of the original folds of the wall, has ceased to be added to, and therefore may be seen (rather on the right hand of the middle of the figure) to terminate in one of the cavities between two adjoining folds. The sutural edges of the compound radii (*d*, fig. 8*b*) are about as thick as, or rather thicker than, in *C. diadema*; for in the middle part they do not reach to the sheath by about half the thickness of the compartment. In the same manner as in *C. diadema* and *reginæ*, each ala here rests, not on the internal surface (as in *C. balænaris*, and in all other Balanidæ) of the radius, but on a special plate (*c*, fig. 8*b*, 8*c*); but in *C. barbara*, instead of there being a deep chamber, running up to the apex of the compartment, between the radius and the special plate, this part is filled up almost entirely by solid shell. Although the extent to which this chamber is filled up varies a little, and although its depth varies a little in *C. diadema*, yet there is a marked difference between the specimens of this latter species, in which the chamber is most filled up, and those of *C. barbara*, in which it is least filled up. The alæ are thick, as in *C. diadema*, and their sutural edges have a central ridge, sending off on both sides sinuous crests. The basal margins of the alæ are not short compared with their upper margins, and therefore the whole ala is not wedge-formed (fig. 8*c*); and in this rather important respect *C. barbara*

resembles *C. balænaris*, and differs from *C. diadema*. The lower edge of the sheath does not seem to have projected freely,—in this respect, also, resembling *C. balænaris*. From the basal margin of the alæ not being narrow, and from the inner ends of the folded walls being, as it would appear, also broad, I have little doubt that the cavity in which the animal's body was lodged, resembled in shape that in *C. balænaris*, the membranous basis being larger than the orifice of the shell.

Opercular valves unknown.

Summary.—This species is more nearly related to *C. diadema* than to the others; but in some points, just specified, it resembles *C. balænaris*. The characters by which it differs from all the species are, firstly, the more prominent transverse ridges on the external surface of the shell, and more especially on the surfaces bounding the outer sides of the cavities occupied by the epidermis of the whale. Secondly, the character of the teeth, or rather ridges, along the lines of junction between the transverse loops. And, thirdly, the spaces between the radii and the special plates on which the alæ rest, being solidly filled up.

The *Coronula bifida* is an Italian tertiary species, so named by Bronn, in his “Italiens Tertiär-Gebilde” (1831), p. 126. It is very possible that this may be identical with *C. barbara*, but Bronn does not seem to have been aware of the absolute necessity of giving minute details in his descriptions of fossil cirripedes. The chief character of *C. bifida* is thus given:—“Eine tiefe Furcle oder Spalte theilt die Längenrippe von oben herab bis zur Hälfte, welche bei der sonst ähnlichen *C. diadema* entweder ganz fehlt, oder nur zuweilen kurz angedeutet ist.” Had it been stated that the longitudinal ribs were divided from the middle down to the base, instead of from the top to the middle, the description would have been intelligible to me, though the character thus afforded would not have been of specific value, as this dividing of the ribs occasionally occurs in all four species, and is produced by the formation of new folds in the walls.

Family—VERRUCIDÆ.

Cirripedia sine pedunculo: scuta et terga, musculis depressoribus non instructa, ex uno latere tantum mobilia, ex altero cum carinâ et rostro in testam asymmetricam immobiliter conjuncta.

Cirripedia without a peduncle: scuta and terga, not furnished with depressor muscles, moveable only on one side, on the other side united immoveably with the rostrum and carina into an unsymmetrical shell.

Genus—VERRUCA.

VERRUCA.¹ *Schumacher*. Essai d'un Nouveau Syst. Class., 1817.

CLYSIA. *Leach*. Journal de Physique, tom. 85, July, 1817; *Clisia*, *Leach*, Encyclop. Brit. Suppl., vol. iii, 1824; *Clitia*, G. B. Sowerby, Genera of Recent and Fossil Shells.

CREUSIA. *Lamarck*. Animaux sans Vertèbres, 1818.

OCHTHOSIA. *Ranzani*. Memoire di Storia Nat., 1820.

LEPAS ET BALANUS AUCTORUM.

The family of Verrucidæ includes only the above single genus; but it has, I think, as good a claim to be considered a distinct Family as either the Balanidæ or Lepadidæ, that is, either the Sessile or Pedunculated Cirripedes. The two latter Families differ from each other almost exclusively in the nature of the shell or external covering, and in the muscles moving the different portions of it: now Verruca has a very peculiar shell, destitute of all muscles, excepting the adductor scutorum, and composed of only six valves, and these are so unequally developed, that the longitudinal dorso-ventral plane of the body comes to lie nearly parallel to the surface of attachment, instead of at right angles to it. Upon the whole, the Verrucidæ are nearly equally related to the Lepadidæ and Balanidæ; but certainly nearer to the Lepadidæ, than to the sub-family Balaninæ or typical sessile cirripedes; though, on the other hand, if compelled to place Verruca in one of these two Families, I should place it amongst the Chthamalinæ, the other sub-family of Balanidæ. The distinctness of Verruca, though in appearance a sessile cirripede, from the Balanidæ or true sessile cirripedes, is interesting, inasmuch as no member of this latter Family has hitherto been found fossil in any Secondary Deposit, whereas Verruca ranges from the present day to the upper beds of the Chalk near Norwich, and in Belgium; being likewise found in the Glacial Deposits, in the Red and Coralline Crags of England, and in an ancient tertiary formation of Patagonia.

The shell of Verruca has generally been quite misunderstood: it consists, as already stated, of six valves; and these can be proved (as I have shown in my volume published by the Ray Society), by tracing the development of the young shell, to consist of a rostrum and carina, unequally developed on their two sides,—of a scutum and tergum in their normal and moveable condition,—and, lastly, of the scutum and tergum on the opposite side, most singularly modified, immoveably articulated to the rostrum and carina, forming together with them a shell, which is firmly united to the basal membrane, and so to the surface of attachment. It can be shown that the very remarkable modification and

¹ According to Bock, in the 'Naturforscher' of 1778, this term was used by Rumph for a Chelonobia, but as it was before the adoption of the binomial nomenclature, according to the Rules, it may be passed over, and does not interfere with the priority of Schumacher.

enlargement of the fixed scutum and tergum, is due to the development of a single small portion in each valve, namely, the lower ridge of the articular ridges by which these valves are united together. It is very remarkable that in all the species it seems to be a matter of chance, whether the right or left hand valves undergo this singular modification; consequently, of every valve it is equally likely to find a right-hand or left-hand specimen; and these, though exactly alike, except in being reversed, or in coming from opposite sides of the body, yet, from this very circumstance, and from the fixed valves being of very irregular shapes, are rather perplexing to identify. This short description will, I hope, suffice to make the following descriptions intelligible.

1. VERRUCA STRÖMIA. Tab. II, fig. 9 a, 9 b.

- LEPAS STRÖMIA. *O. Müller.* Zoolog. Dan. Prod., No. 3025, 1776.
 — — — *Id.* Zoolog. Dan., vol. iii, Tab. 94, 1789.
 — STRIATA. *Pennant.* British Zoology, vol. iv, Tab. 38, fig. 7, 1777.
 DIE WARZENFORMIGE MEEREICHEL. *Spengler.* Schriften der Berlin. Gesell., 1 B.,
 Tab. 5, fig. 1—3, 1780.
 LEPAS VERRUCA. *Spengler.* Skrifter af Naturhist. Selskabet, 1 B., 1790.
 — — — ET STRÖMIA. *Gmelin.* Syst. Nat., 1789.
 BALANUS VERRUCA. *Bruguère.* Encyclop. Meth., 1789; *Clisia verrucosa*, Deshayes, in
 Tab.
 — INTERTEXTUS. *Pulteney.* Catalogue of Shells of Dorsetshire, 1799.
 LEPAS STRIATUS. *Montagu.* Test. Brit., 1803.
 — VERRUCA. *Wood's* General Conchology, Pl. 9, fig. 5, 1815.
 VERRUCA STRÖMII. *Schumacher.* Essai d'un Nouveau Syst. Class., 1817.
 CREUSIA STRÖMIA ET VERRUCA. *Lamarck.* Animaux sans Vertèbres, 1818.
 OCHTHOSIA STROEMIA. *Ranzani.* Memoire di Storia Nat., 1820.
 CLISIA STRIATA. *Leach.* Encyclop. Brit. Suppl., vol. iii (sine descript.), 1824.
 CLITIA VERRUCA. *G. B. Sowerby.* Genera of Recent and Fossil Shells, Plate.
 VERRUCA STRÖMII. *J. E. Gray.* Annals of Philosophy (new series), vol. x, Aug. 1825.

V. scuto mobili, cristâ articulari inferiore dimidiam brevis cristæ articularis superioris latitudinem non æquante: testâ plerumque longitudinaliter sulcatâ.

Moveable scutum, with the lower articular ridge not half as broad as the short upper articular ridge: shell generally ribbed longitudinally.

Fossil in Glacial deposits of Scotland, Mus. Lyell; Red Crag (Walton, Essex), Coralline Crag (Sutton), Mus. S. V. Wood.

Recent on the shores of Great Britain and Ireland; Shetland Islands; Denmark; Iceland; shores of northern Europe; Red Sea. Attached to shells, laminariæ, rocks, crabs, and floating bark, from low tidal mark to fifty or ninety fathoms.

I have seen a perfect specimen of this species from the Glacial deposits of Scotland, and

separated valves from the Red and Coralline Crag, collected by Mr. S. Wood. The moveable opercular valves have not been discovered; and these are certainly much the most important parts for the diagnosis of the species; but the other valves are tolerably perfect, and are undistinguishable from recent specimens of *V. Strömia*; therefore, I have ventured, with some hesitation, thus to name these specimens. The fossil specimens all belong to the common variety, having its shell longitudinally ribbed, a character not observed in the four other species of the genus. As an aid to collectors in the Crag, I have thought it would be more serviceable to give a drawing (fig. 9 *a*), from a recent specimen, of all the six valves, separated, but in as nearly as possible their proper relative positions, and likewise of the under side of the fixed scutum and tergum, than to give fac-similes of such valves, in themselves not perfectly characteristic, which have as yet been discovered fossil.

It should be borne in mind, that of the six valves of which figures are here given, it is just as likely that reversed specimens from the opposite side of the body should be found, as these which represent valves taken from a specimen in which the left-hand scutum and tergum were fixed and formed part of the shell.

2. VERRUCA PRISCA. Tab. II, fig. 10*a*—10*c*.

VERRUCA PRISCA. *Bosquet*. Monographie des Crustacés fossiles du Terrain Crét. de Limbourg, Tab. 1, fig. 1—6; 1853.

V. testá lævi; scuti mobilis cristá articulari inferiore aliquanto latiore quam superior.

Shell smooth: moveable scutum, with the lower articular ridge somewhat broader than the upper articular ridge.

Fossil in Chalk, Norwich, Mus. J. de C. Sowerby: 'Système Senonien et Maestrichtien,' Belgium, Mus. Bosquet.

M. Bosquet has admirably figured and described the several separated valves belonging to this species, and I owe to his great kindness an examination of some of them. In Mr. J. de C. Sowerby's collection, also, there is a single specimen (fig. 10*a*), attached to a Mollusc, with the four valves of the shell united together, but without the two moveable opercular valves; it cannot be positively asserted that this is the same species with that of M. Bosquet, but such probably is the case. The opercular valves (fig. 10*b*, 10*c*) are necessarily figured from Belgian specimens. It is the English specimen to which I alluded in the Introduction to my 'Monograph on Fossil Lepadidæ.' This species of *Verruca* is interesting, from being the only known Secondary one, but in itself it is a

very poorly characterised form, and I can point out no important character in the shell by which it can be recognised. The rostrum and carina, which are of nearly equal sizes, are locked together, and likewise to the fixed scutum and tergum, by the usual interfolding plates; the plates between these latter valves seem to have been less developed in M. Bosquet's specimen than in the English. The fixed scutum has a large adductor plate, which seems to have been chipped in M. Bosquet's specimen; this valve and the fixed tergum in all essential respects resemble the same valves in *V. Strömia*. The surface of the shell is very smooth.

The *moveable scutum* has its occludent margin considerably arched: the lower articular ridge is broader than the upper ridge, in which respect it resembles the same valve in *V. lævigata*, a South American form, but the whole valve is not so broad as in that species. There is no adductor ridge on the under surface. The *moveable tergum* has its upper articular ridge narrow, and slightly produced into a point on the scutal margin: in this latter respect this species, also, resembles *V. lævigata*, but differs from it in the whole valve not being so broad in proportion to its height.

TAB. I.

Fig. 1*a*, *Balanus tintinnabulum*, nat. size; small specimen.

1*b*, „ „ rostrum, internal view of, large specimen, nat. size.

1*c*, 1*d*, „ „ scutum and tergum, internal views of, from recent specimens, the opercular valves not having been found fossil.

Fig. 2*a*, *Balanus calceolus*, engraved from a recent specimen, the single fossil having been injured during examination.

2*b*, 2*c*, „ „ scutum and tergum, internal views.

2*d*, Spur of tergum, variety: all from recent specimens, the opercular valves not having been found fossil.

Fig. 3*a*, 3*b*, *Balanus spongicola*, scutum and tergum, external views.

3*c*, 3*d*, „ „ „ „ internal views.

3*e*, „ „ shell, enlarged from a recent specimen, the single fossil being young, and having been injured by examination.

Fig. 4*a*, *Balanus concavus*, shell (Coralline Crag specimen).

4*b*, „ „ internal view of part of the carina (to the left hand), of the carino-lateral compartment, and of part of the lateral compartment, showing the raised borders (*r*) on the rostral sides of the sutures in the sheath (Italian Tertiary specimen).

4*c*, „ „ shell, *var.*, with longitudinal ridges or ribs not prominent (Coralline Crag).

4*d*, „ „ smooth *var.* (Piedmont specimen).

4*e*, „ „ scutum, external view (Coralline Crag).

4*f*, „ „ „ internal view do.

4*g*, „ „ tergum, external view do.

4*h*, „ „ scutum, internal view (Maryland, U.S.).

4*i*, „ „ tergum, internal view do.

4*k*, „ „ „ external view do.

4*l*, „ „ scutum, external view (Portugal fossil, and recent).

4*m*, „ „ tergum, external view do. do.

4*n*, „ „ scutum, internal view do. do.

4*o*, „ „ tergum, external view, very large specimen (Turin).

4*p*, „ „ scutum, small portion, at the rostral corner, highly magnified, very large specimen (Turin).

Fig. 5*a*, *Balanus porcatus*, shell, nat. size (Red Crag).

FOSSIL CIRRIPIEDIA.

5*b*, *Balanus porcatus*, small portion of basal margin of wall, much enlarged.

5*c*, „ „ portion of basal plate, much enlarged.

5*d*, 5*e*, 5*f*, 5*g*, *Balanus porcatus*, scutum and tergum, external and internal views ;
engraved from recent specimens, the opercular
valves not having been positively found fossil.

Fig. 6*a*, *Balanus crenatus*, twice nat. size (Red Crag).

6*b*, „ „ small portion of basal margin of wall, much enlarged.

6*c*, „ „ portion of basal plate, of unusual thickness, much enlarged.

6*d*, 6*e*, „ „ scutum and tergum, external views from recent specimens.

6*f*, 6*g*, „ „ „ „ *var.*, internal views from recent specimens.

Fig. 7*a*, 7*b*, *Balanus Hameri*, scutum and tergum, external views engraved from Canada
glacial specimens, the opercular valves not having been
found in Great Britain.

7*c*, 7*d*, „ „ scutum and tergum, internal views of very large and old
specimens (Canada and Uddevalla).

TAB. II.

- Fig. 1*a*, *Balanus Hameri*, lateral compartment, viewed externally.
 1*b*, „ „ carino-lateral compartment, viewed internally.
- Fig. 2*a*, *Balanus bisulcatus*, shell, $1\frac{1}{2}$ nat. size.
 2*b*, „ „ rostrum, viewed externally, to show the commencement of the folding of the walls, $1\frac{1}{2}$ nat. size.
 2*c*, „ „ *var. plicatus*, thrice nat. size.
 2*d*, „ „ very young shell, probably belonging to this species, enlarged about seven times.
 2*e*, 2*f*, „ „ scutum and tergum, external views.
 2*g*, 2*h* „ „ „ „ internal views.
- Fig. 3*a*, *Balanus dolosus*, rostrum, much enlarged, viewed internally.
 3*b*, „ „ portion of basal plate, much enlarged.
 3*c*, 3*d*, „ „ scutum and tergum, external views.
- Fig. 4*a*, *Balanus unguiformis*, shell, twice nat. size.
 4*b*, „ „ shell, *var. erisma*, twice nat. size.
 4*c*, 4*d*, „ „ scutum and tergum, external views.
 4*e*, 4*f*, „ „ „ „ internal views.
- Fig. 5*a*, *Balanus inclusus*, shell, nearly thrice nat. size.
 5*b*, „ „ basis of ditto, showing basal edges of the compartments.
 5*c*, „ „ *var.*, with its rostro-carinal axis elongated.
 5*d*, „ „ *var.*, „ „ „ „ showing the narrow furrowed basis and lower portions of the six compartments.
 5*e*, „ „ *var.* intermediate between the last two varieties, basal view of, nearly twice nat. size.
 5*f*, 5*g*, „ „ scutum and tergum, internal views from a very young specimen.
- Fig. 6*a*, *Acasta undulata*, rostrum viewed externally; spinose *var.*; twice nat. size.
 6*b*, „ „ lateral compartment, smooth *var.*, twice nat. size.
 6*c*, „ „ basal cup.
 6*d*, „ „ scutum viewed internally.
 6*e*, 6*f*, „ „ „ and tergum viewed externally.
- Fig. 7*a*, *Pyrgoma Anglicum*, shell, viewed from above, four times nat. size.
 7*b*, „ „ scutum, internal view.
 7*c*, „ „ tergum, internal view, engraved from recent specimen, this valve not having been found fossil.

FOSSIL CIRRIPIEDIA.

Fig. 8*a*, *Coronula barbara*, rostrum, external view; nat. size.

8*b*, „ „ „ viewed internally; twice nat. size.

8*c*, „ „ lateral compartment, internal view.

8*d*, „ „ internal view, much enlarged, of small portion of basal margin of folded wall.

8*e*, „ „ external view, greatly enlarged, of small portion of surface of folded walls, near the basal margin; (*r r*) the transverse ridges of growth.

The following letters of reference apply to all the figures of *Coronula*:

a, sheath marked transversely in the upper part by the attachment of the opercular membrane.

a', ala

b, furrow on each side of (*a*), receiving the edge of the thick ala of the adjoining lateral compartment.

c, special plate, on which the ala rests.

d, radius, on the edge it may be just seen to consist of an outer layer (the normal radius), and a much thicker inner part (the pseudo or complementary radius) formed of oblique denticulated septa.

e e' e'', basal edge of wall, which from its commencement at *e*, or *e''*, can be followed, folding up to near the basal edge of the sheath, to its termination at *e''* or *e*.

ff, serrated lines of junction between the folds of the wall.

Fig. 9*a*, *Verruca Strömia*, much enlarged, engraved from a recent specimen, only certain valves having been found fossil.

9*b*, „ „ fixed scutum and tergum, internal views. The following letters apply to both these figures:

A, rostrum.

B, carina.

s, moveable scutum, *s'*, scutum fixed and modified so as to form part of shell.

t, moveable tergum, *t'*, tergum fixed, forming part of shell.

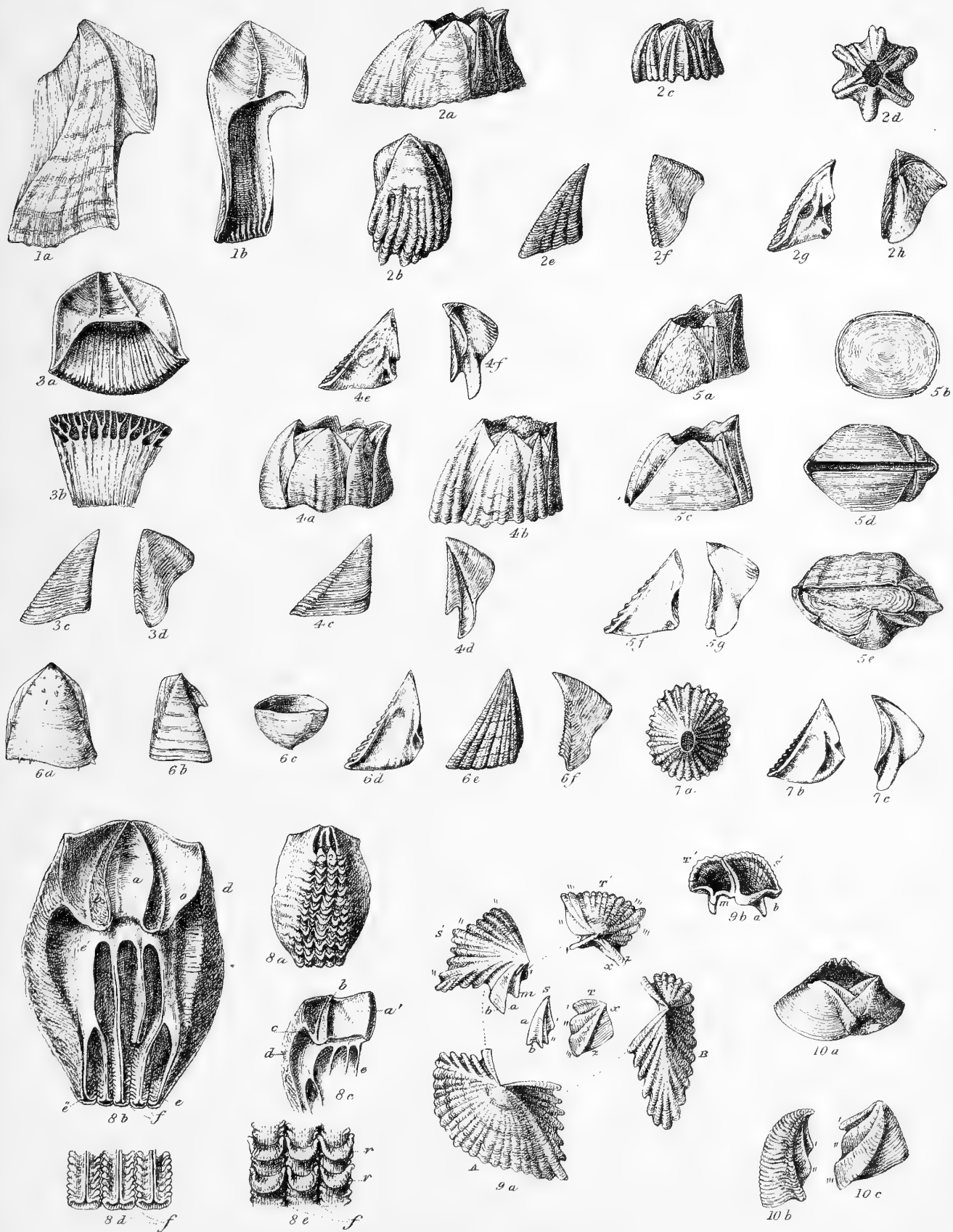
In *s*, and *s'*, *a* is the occludent margin; *b*, the basal margin; *m*, the plate to which the adductor muscle is fixed.

In *s* and *s'*, the tergal margin is marked by small dashes; (') being the upper articular ridge, and (") the second or lower articular ridge: in *s'* (") is called the parietal portion of the valve.

In *t* and *t'*, the scutal margin is marked by small dashes; (') being the first and upper articular ridge, hardly distinct from the occludent margin, and called in *t'* the occludent rim; (") is the second or middle, and (""') the lower or third articular ridge, called in *t'* the parietal portion of the valve: *x* is the carinal margin, called in *t'* the carinal rim, and *z* the basal margin.

Fig. 10*a*, *Verruca prisca*, five times nat. size.

10*b*, 10*c*, „ „ scutum and tergum, external views; engraved from a Belgian Cretaceous specimen, the opercular valves not having been found in England.



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DESCRIPTION
OF THE
FOSSIL REMAINS OF MOLLUSCA
FOUND IN THE
CHALK OF ENGLAND.

BY
DANIEL SHARPE, F.R., GEOL., & L.S.

PART II.
CEPHALOPODA.

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9. AMMONITES WOOLLGARI, *Mantell*. Plate XI, fig. 1 and 2.

AMMONITES WOOLLGARI, *Mantell*. Fossils of the South Downs, t. xxi, fig. 16; t. xxii, fig. 7.

- | | | |
|---|---|---|
| — | — | <i>Sowerby</i> . Min. Con., t. 587, fig. 1. |
| — | — | <i>D'Orbigny</i> . Prodrome de Paléontologie, p. 189. |
| — | — | (not), <i>D'Orbigny</i> . Pal. Franç., t. 108, fig. 1-3. |
| — | | CAROLINUS? <i>D'Orbigny</i> . Loc. cit., t. xci, fig. 5, 6. |

A. testá subcompressá, costatá, tuberculatá, interruptè carinatá: juniore, costis 16-18 elevatis, tri-tuberculatis, dorso interruptis, cariná dorsali profundè serratá; adolescenti, costis rarioribus ad dorsum uni-tuberculatis, cariná dorsali obsoletá; adultá, costis bi-tuberculatis, tuberculis maximis, dorso concavo: umbilico lato: aperturá oblongá.

Shell compressed, ribbed, tuberculated, and keeled; changing its form and ornaments as it enlarges; when two to three inches in diameter it has sixteen to eighteen sharp, elevated ribs on the side of each whorl, each rib bearing three tubercles, one near the umbilicus and two near the back; the back has a sharp and deeply serrated keel, the serrations corresponding in number to the ribs: when about four inches in diameter, the keel is less prominent, the ribs are fewer and nearly obsolete, and bear one enormous tubercle at their dorsal end: as the shell continues to enlarge, the whorl grows broader, and has two rows of ten very large tubercles on each side, one close to the umbilicus, the other at the dorsal edge, the back has entirely lost its keel, and is smooth and hollow between the dorsal tubercles: umbilicus large and shallow, with two thirds of the whorls exposed: aperture at first oblong and narrow, ultimately nearly of equal height and breadth. The septa have not been clearly seen, they appear to have four or five trifid lateral lobes.

Diameter of old shell, 1 foot; width, 3 inches.

A rare shell in the Middle and Lower Chalk of Sussex.

There is hardly any species of Ammonite which undergoes so great a metamorphosis as *A. Woollgari*; the young and middle stages of growth were well figured by Dr. Mantell; the older stage is not often met with, the only specimen which I have seen is in Mr. Baber's collection, but is too imperfect to figure. The shell described as *A. Woollgari* in the 'Paléontologie Française,' has no resemblance whatever to Dr. Mantell's species; this error is pointed out by M. d'Archiac, in the 'Histoire des Progrès de la Géologie,' vol. iv, p. 347, note, and has been corrected by M. d'Orbigny in the 'Prodrome de Paléontologie,' vol. ii, p. 188. In the latter work M. d'Orbigny quotes his *A. Carolinus*, Pal. Franç., t. 91, fig. 5 and 6, as the young of *A. Woollgari*; which identification is very doubtful, as the French shell has twice as many ribs, is less compressed, and has the keel more completely separated from the ribs by two regular channels, than our species.

10. AMMONITES GRIFFITHII, *Sharpe*. Plate XI, fig. 3.

A. testá discoideá lævi, sulcis 4 vel 5 flexuosis ornatá: dorso rotundato (impresso?), umbilico parvo: aperturá semiovali: septorum marginibus ramosissimis, lobis trifidis.

Shell discoidal, smooth; each whorl crossed by four or five slightly waved, transverse furrows, bounded on each side by a slight elevation; back rounded and marked in the cast by a small medial groove; umbilicus small and well defined; whorls four fifths concealed; aperture semi-oval; margins of the septa very complex, with four trifid lateral lobes.

Diameter, 5 inches; width $2\frac{1}{2}$ inches.

Found in the hard Chalk of Aughanloe and Benbraddagh, in the County of Derry, by the Ordnance Geological Surveyors.

The specimens examined being all internal casts, the above description is necessarily imperfect, and may require modification when better materials are found. The species is nearly allied to *A. Lewesiensis*, Sow., and *A. Majorianus*, d'Orb.; it is distinguished from the former by its transverse furrows, from the latter by less breadth at the back, and from both by the want of transverse ribs, and a smaller umbilicus: the lobes of the septa of the three species are much alike. The shell is named after Richard Griffith, Esq., to whose labours we are indebted for the Geological Map of Ireland.

11. AMMONITES AUSTENI, *Sharpe*. Plate XII, fig. 1 and 2.

A. testá discoideá, compressá, transversim costatá; costis flexuosis inæqualibus, majoribus paucis ambulacrum amplexentibus, minoribus numerosis dorsalibus: dorso rotundato: umbilico parvo: aperturá rotundato sagittatá.

Shell discoidal, transversely ribbed: whorls flattened at the sides, rounded over the back, ornamented with numerous unequal flexuous ribs, all passing over the back, of which a few, larger than the rest, embrace the whole whorl, the others only reaching to the middle of the side; the number of larger ribs varies, being eight or ten on the whorl of a young, and about twenty on that of an old shell: back narrow and rounded: umbilicus small, and bounded by steep sides exposing half the inner whorl: aperture bluntly sagittate.

Diameter of the specimen fig. 1, 16 inches; height of outer whorl, 6 inches; width of the aperture, $3\frac{1}{2}$ inches: it often reaches much larger dimensions.

Found in the Grey Chalk of Surrey, Kent, and Sussex, and in the Upper Green Sand near Dorking.

It is singular that a species to be found in abundance near London should never have been published; it has probably been mistaken by collectors for *A. planulatus*, Sow., to which it has some resemblance; but that species has transverse furrows where this has

projecting ribs. I have named it after Robert A. C. Austen, Esq., F.R. and G.S., in whose neighbourhood at Chilworth, this Ammonite is very abundant.

12. *AMMONITES PLANULATUS*, *Sowerby*. Plate XII, fig. 3 and 4.

AMMONITES PLANULATUS, *Sowerby*. Mineral Conchology, t. 570, fig. 5.

A. testá discoideá: anfractibus complanatis, externè costatis, internè lævibus; sulcis 5 transversis subflexuosis, impressis; costis numerosis, brevibus: dorso rotundato transversim costato: umbilico magno: aperturá semi-ovatá: lobis septorum lateralibus inæqualiter bifidis.

Shell discoidal, with four or five whorls flattened on the sides, and rounded on the back, crossed by five deep, slightly flexuous furrows, between which are many short slight ribs, which cross over the back and only reach the middle of the side of the whorl: umbilicus large and well-defined, leaving three fifths of the inner whorls visible: aperture semi-oval: lateral lobes of the septa unequally bifid.

Diameter, $2\frac{1}{2}$ inches.

Rare in the Grey Chalk near Lewes and Bonchurch; common in the Upper Green Sand near Cambridge.

I have seen but few specimens of this species from the Chalk, and as that originally figured by Sowerby is badly preserved and somewhat crushed, and does not show the margins of the septa, a figure is added of a well preserved internal cast from the Upper Green Sand. M. d'Orbigny unites to Sowerby's species, under the name of *A. Mayorianus*, an Ammonite found in the Lower Green Sand and Gault of France, which differs from our species in having only four transverse furrows instead of five, the furrows more flexuous, and bounded by stronger swellings, and the cast entirely smooth; it has, moreover, the lateral lobes of the septa trifid, which distinguishes it from Sowerby's species. I cannot, therefore, regard his species as identical with ours. M. d'Orbigny's reason for dropping Sowerby's specific name, that it had been previously used by Schlotheim for another species, is also insufficient: since Schlotheim's species being abandoned by every one, including M. d'Orbigny himself, 'Terr. Jurass.,' vol. i, p. 509, the name remains open for the next species to which it has been applied, which is the one here described.

13. *AMMONITES CATINUS*, *Mantell*. Plate XIII, fig. 1.

AMMONITES CATINUS, *Mantell*. Fossils of the South Downs, t. xxii, fig. 10. (Not t. xxii, fig. 5.)

A. testá inflatá: anfractibus paucis, latis, rotundatis, lateribus 10-12 tuberculatis, dorso lævibus: umbilico lato, profundo: aperturá transversá, semi-circulari.

Shell gibbous, with three or four broad whorls, depressed and smooth on the back,

elevated and tuberculated on the sides near the large and deep umbilicus; tubercles 10 to 12 on each whorl, large and ill-defined; inner whorls half concealed: aperture transverse, nearly semicircular.

Diameter, 10 inches; width of aperture, 5 inches.

Very rare in the Grey Chalk of Wiltshire and Sussex.

This rare Ammonite, of which only two specimens have been met with, is the only species yet known in the Chalk of the Family of the Coronarii, so abundant in the middle Oolites.

A misprint in the explanation of Dr. Mantell's Plate xxii, where fig. 5, is called *A. catinus* instead of *A. navicularis*, has led to this species being confounded with *A. Mantellii*, both in the 'Paléontologie Française,' and in Bronn's 'Index Paleontologicus.'

14. AMMONITES PORTLOCKI, *Sharpe*. Plate XIII, fig. 2 and 3.

AMMONITES FISSICOSTATUS, *Portlock*. Geology of Londonderry, &c., pp. 408 and 764.

A. testá inflatá, costatá, tuberculatá: ambulacris rotundatis: juniore, tuberculis lateralibus 10, costis 20 transversis, dorso interruptis; adultá, tuberculis binis, dorsalibus, majoribus; costis rarioribus: umbilico parvo, profundo: aperturá transversim ovali: septorum marginibus lateraliter trilobatis, lobis trifidis.

Shell gibbous, with few rounded whorls wider than high, and a small deep, smooth umbilicus: when one and a half to two inches in diameter the whorl has ten large blunt tubercles on the middle of each side, and twenty strong rounded ribs, rising either singly or in pairs from the tubercles, and curving slightly forward to near the middle of the back, where they become obsolete; when three inches in diameter only one rib rises at each tubercle, which bears a second larger tubercle near the middle of the back, and the intervening ribs disappear: in the internal cast the back has a slight medial groove: inner whorls nearly half concealed: aperture transversely oval: septa with three trifid lateral lobes.

Diameter, 3 inches; width of aperture 2 inches.

Found in the hard Chalk of Tamlaght, in the county of Derry, by the Ordnance Geological Surveyors.

The young shell bears some resemblance to *A. fissicostatus*, to which this species was first referred, but it is distinguished by more transverse whorls and fewer ribs, and at a later stage of growth by the large dorsal tubercles. I have named it after Lieutenant Colonel Portlock, R.E., who conducted the Geological branch of the Ordnance Survey of Ireland at the time the specimens were found, and first published a notice of them.

15. AMMONITES EUOMPHALUS, Sharpe. Plate XIII, fig. 4.

A. testá inflatá, costatá, tuberculatá: anfractibus latis, dorso depressis, lateribus angulatis, spinosis: costis inæqualibus; majoribus alternantibus latero bi-tuberculatis, ad dorsum bifidis: dorso depresso, transversim costato, demum tuberculato: umbilico magno, profundo: aperturá transversá, angulatá: septorum marginibus lobis 4 trifidis simpliciusculis.

Shell gibbous, with a broad flattened back and angular whorls, crossed by numerous unequal tuberculated ribs, which bifurcate at the back; the ribs are about twenty in number on the side of the whorl, alternately larger and smaller; the larger ribs bearing a small tubercle near the umbilicus, and a strong spine at the edge of the back; the number of ribs on the back is about double that on the sides of the whorl, two springing from each spine, curving forwards and meeting again at the opposite spine; about every fourth dorsal rib is larger than the others, and bears two slight tubercles: umbilicus broad and funnel-shaped, leaving three fourths of the inner whorls visible: aperture transverse and angular: septa with four very simple, trifid, lateral lobes, and the lateral saddle very small.

Diameter, three fourths of an inch; width of aperture, half an inch; height of the last whorl, one third of an inch.

From the base of the Lower Chalk, at Man of War Cove, on the coast of Dorsetshire, in the collection of E. H. Bunbury, Esq.

Only one imperfect specimen of this pretty Ammonite has been seen; in many characters it is closely related to *A. Martinii*, D'Orb., having, like that species, the lateral saddle much smaller than the first auxiliary saddle, but it has a flatter back than *A. Martinii*, and somewhat different ribbing.

16. AMMONITES LATICLAVIUS, Sharpe. Plate XIV, fig. 1.

A. testá discoideá: anfractibus paucis, planatis, costatis, tuberculatis; costis 35 radiantibus, 8-tuberculatis, dorso interruptis: umbilico parvo: dorso, marginibus bi-tuberculatis, medio planiusculo: aperturá rhomboidali.

Shell with three or four whorls, flattened on the sides; ornamented on each side with thirty-five equal, straight ribs, each bearing four tubercles, not continued across the back; in the young shell the ribs are either single, or unite in pairs at the umbilical tubercle, but after reaching a diameter of three inches, each rib is quite distinct: tubercles in eight, nearly equidistant rows, three on the flat side of the whorl, and one on each side of the back: umbilicus small and well defined, leaving four fifths of the inner whorls visible: back smooth and hollow between the tubercles: aperture rhomboidal.

Diameter, $6\frac{1}{2}$ inches; height of last whorl, 3 inches; width of aperture, $2\frac{1}{2}$ inches.

A very rare shell in the Grey Chalk of the Isle of Wight.

This species belongs to the large group of Ammonites with squared whorls and straight

tuberculated ribs, of which *A. Rhotomagensis* is usually taken as the type; the septa have not been well seen.

17. AMMONITES OLDHAMI, *Sharpe*. Plate XIV, fig. 2.

AMMONITES ALTERNATUS, *Portlock*. *Geology of Londonderry, &c.*, pp. 408 and 764.

A. testá discoideá: anfractibus ellipticis, transversim radiatis; radiis alternatim majoribus, dorso interruptis: dorso rotundato, impresso: umbilico magno: aperturá semi-ovali: lobis septorum trifidis ramosissimis.

Shell discoidal, with slightly flattened, rounded whorls, ornamented with numerous transverse ribs, alternately reaching the umbilicus, or stopping on the side of the whorl, but all interrupted at the back: umbilicus large and shallow, leaving one third of the inner whorls visible: back marked in the internal cast with a slight medial groove: aperture semi-elliptical: margins of the septa with three trifid, branching, lateral lobes.

Diameter, 4 inches; height of last whorl, $1\frac{3}{4}$ inch, width of aperture $1\frac{1}{4}$ inch.

Found in the hard Chalk of Dungiven, in the County of Derry, by the Ordnance Geological Surveyors.

This species is closely allied to *A. Lewesiensis*, Sow., having the same general form and grooved back, and nearly similar septa; the most obvious distinction is in the ribs, which in *A. Lewesiensis* are equal, and all die out on the side of the whorl without reaching the umbilicus. Having only seen one waterworn specimen of *A. Oldhami*, I offer the description of it with some diffidence. It is named after Thomas Oldham, Esq., of the Ordnance Geological Survey of Ireland.

A. alternatus, Woodward, should be expunged from our catalogues, resting on an execrably drawn figure of a broken specimen of *A. interruptus*; which I learned from seeing Woodward's original drawing, in the possession of Mr. S. P. Woodward of the British Museum.

18. AMMONITES LEPTONEMA, *Sharpe*. Plate XIV, fig. 3.

A. testá discoideá, compressiusculá, transversim subtilissimè costatá: costis numerosissimis, simplicibus, flexuosis, ambulacrum totum amplexentibus: umbilico magno: dorso angustato, rotundato: aperturá sagittato-ovatá.

Shell discoidal, with four whorls rounded at the umbilicus, and slightly compressed towards the back, enlarging rapidly, and ornamented by very numerous, equal, fine, thread-like, flexuous ribs, which embrace the whole whorl; umbilicus large and shallow; back narrow, and rounded; aperture ovate.

Diameter, $1\frac{3}{4}$ inch, height of last whorl, seven eighths; width of aperture, five eighths of an inch.

Very rare in the Grey Chalk of Ventnor, Isie of Wight.

This species resembles *A. Velledæ*, Mich., in its general form and elegant thread-like ribs, but is at once distinguished by its larger umbilicus. The specimen figured is the only one which has come under my notice.

19. AMMONITES RHOTOMAGENSIS, *Defrance*. Plate XVI, fig. 1—4.

AMMONITES RHOTOMAGENSIS, *Brongniart*. Environs de Paris, t. vi, fig. 2.

— — *Sowerby*. Min. Conch., t. 515.

— — *Bronn*. Lethæa Geogn., t. xxxiii, fig. 1—3.

— — *D'Orbigny*. Pal. Franç., t. 105 and 106.

— SUSSEXIENSIS, *Mantell*. Geol. Sussex, t. xxi, fig. 10. (Not t. xx, fig. 2.)

A. testâ discoideâ, costatâ, tuberculatâ: anfractibus tumidis, quadrato-rotundatis: costis rectis, simplicibus, rotundatis, æqualibus; junioribus septem, adultis sex-tuberculatis: dorso juniore rotundato, tuberculis triserialibus; adulto bituberculato, transversim costato, vel medio plano: umbilico magno: septorum lobis lateralibus inæqualiter bifidis?

Variat anfractibus planiusculis, tuberculatis; costis subobsoletis; dorso plano.

Shell discoidal; whorls tumid, flattened at the back and sides, with nearly a square section; about one third concealed; crossed by about twenty-four simple, straight, rounded ribs, which when young bear seven tubercles, and when full grown six tubercles each; the tubercles are thus placed,—one row near the umbilicus, and two rows on each side of the back, the seventh row on the middle of the back disappears in adult shells, leaving the back either smooth and flat, or crossed by a continuation of the ribs; umbilicus large and ill-defined, with sloping sides. The lateral lobes of the septa are unequally bifid?

Diameter, 8 inches; width, $3\frac{1}{2}$ inches; height of aperture, 3 inches.

Very abundant in the Grey Chalk of all the southern counties, and in the Chloritic Marl of the Isle of Wight, and Chalk with silicious grains of the West of England.

The *A. Rhotomagensis*, as above defined, presents very constant characters; from its youngest stage, fig. 3, till it has attained about two thirds of its full size, the only change is a gradual increase in the number of the ribs, but the form and number of the tubercles continues the same; this distinguishes it from *A. Sussexiensis* and *A. Cunningtoni*, in both of which the dorsal are, in young shells, more numerous than the lateral tubercles. In the adult *A. Rhotomagensis* the tubercles on the middle of the back disappear; in some specimens the ribs are continued prominently across the back, in others the back is flat and nearly smooth. The size at which the change takes place varies very much. Specimens are often found which, though less than three inches in diameter, have all the characters of the adult shell, one of these is represented of the natural size in fig. 2; but more frequently they reach nearly six inches in diameter before losing the dorsal tubercles, as in the case of fig. 1. The superior lateral lobe of the septa is always bifid, with more or less unequal terminal branches; the termination of the next lateral lobe varies, some

specimens having it distinctly trifold, as it is figured in the 'Pal. Franç.,' fig. 106, while others have it unequally bifid.

A marked variety is found in the Chalk with siliceous grains of Somersetshire and Dorsetshire, in which the ribs are nearly obsolete; but the general form of the shell, the tubercles, and the outline of the septa identify the species.

M. d'Orbigny unites *A. hippocastanum*, Sow., to *A. Rhotomagensis*, in which I cannot coincide; the unequal ribs of the former contrasting too strongly with the extreme regularity of the latter to admit of their belonging to one species.

20. AMMONITES SUSSEXIENSIS, *Mantell*. Plate XV, fig. 1.

AMMONITES SUSSEXIENSIS, *Mantell*. Geol. Sussex, t. xx, fig. 2. (Not t. xxi, fig. 10.)

A. testá discoideá, costatá, tuberculatá: anfractibus tumidis, quadrato-rotundatis: costis rectis, lateraliter simplicibus, bituberculatis; junioribus, dorso bi- vel tri-divisis, tri-tuberculatis; adultis, dorso continuis simplicibus: umbilico magno: septorum lobis lateralibus, primo bifido, secundo trifido.

Shell discoidal; whorls tumid, flattened at the back and sides, with nearly a square section, very little concealed; ornamented with sixteen or eighteen tuberculated ribs; on the sides of the whorls the ribs are all equal, straight, rounded, and bearing two large tubercles, one near the umbilicus, the other near the back; but the dorsal portion of the ribs varies with the age of the shell; at three inches diameter (the youngest examined) each rib divides on the back into two or three ribs, which reunite at the opposite tubercles and bear three small tubercles each; a little later it is only the middle tubercle which is divided into two; after this the rib is continued across the back as in one form of *A. Rhotomagensis*: umbilicus very large, concealing hardly one fifth of the inner whorls. The superior lateral lobe of the septa is bifid, the inferior lateral lobe trifid.

Diameter, 6 inches; width, 2 inches; height of aperture, $2\frac{1}{4}$ inches.

Found occasionally in the Grey Chalk near Lewes, Sussex.

The two shells originally figured in the Geology of Sussex by Dr. Mantell, under the name of *A. Sussexiensis*, belonged to two different species, to one of which the name of *A. Rhotomagensis* had just before been given in France; the other being the species above described as *A. Sussexiensis*. The distinctions between them having been overlooked, they were united together by Sowerby in the 'Mineral Conchology,' vol. vi, p. 25, and all subsequent authors having adopted the same view, *A. Sussexiensis* has been viewed as a synonym of *A. Rhotomagensis*: the adult shells, though a good deal alike, may be distinguished by the number of their ribs, but in their younger stage the differences in the dorsal ribs and tubercles are too great to allow of any confusion between them.

21. AMMONITES CUNNINGTONI, Sharpe. Plate XV, fig. 2.

A. testá inflatá, tuberculato-spinosá: anfractibus tumidis rotundatis; lateraliter biseriatim spinosis; dorso planulatis, tuberculatis: tuberculis dorsalibus imprimis tri-serialibus, medio numerosioribus, deinde obsoletis: umbilico magno: aperturá transversim ovali: septorum lobis lateralibus, superiore bifidá, inferiore trifidá.

Shell with few broad rounded whorls, each with two lateral rows of about ten spinose tubercles, one row of moderate size near the umbilicus, the other of large spines at the edge of the back: three rows of smaller elongated tubercles on the back; those of the two outer rows corresponding in number to the lateral spines; in the central row two or three smaller tubercles to each of the others: as the shell increases in size the tubercles of the middle row gradually disappear, and the other dorsal tubercles coalesce with the spines, leaving the back smooth, and only four rows of large spines on the whorl: umbilicus large, leaving nine tenths of the inner whorls visible: aperture transversely oval: superior lateral lobe of the septa bifid, inferior lateral lobe trifid.

Diameter, 6 inches; width, $3\frac{1}{4}$ inches; height of aperture, $2\frac{1}{2}$ inches.

The only specimen seen was found in the Grey Chalk of Upton Scudamore, near Warminster.

This species is nearly related to *A. Sussexiensis*, from which it is distinguished by its broader whorls, fewer and larger lateral tubercles, and different arrangement of the dorsal tubercles. The species is named after William Cunnington, Esq., F.G.S., of Devizes, whose zeal in illustrating the Geology of his neighbourhood entitle him to our gratitude.

PLATE XI.

Fig.

1*a* and *b*. AMMONITES WOOLLGARI; from the Grey Chalk near Lewes; the original specimen in Dr. Mantell's collection, figured in his work, and in the 'Mineral Conchology,' and now in the British Museum. The portions marked R are restored by the artist.

2*a* and *b*. AMMONITES WOOLLGARI; a young specimen from the Middle Chalk near Lewes; in the collection of Henry Catt, Esq., of Brighton.

3*a*, *b*, and *c*. AMMONITES GRIFFITHII; internal cast from the Hard Chalk of the County of Derry; fig. 3*a* has been completed in the inner whorls from another specimen, and fig. 3*c* drawn from a third specimen, all in the collection of the Museum of Practical Geology, in London.

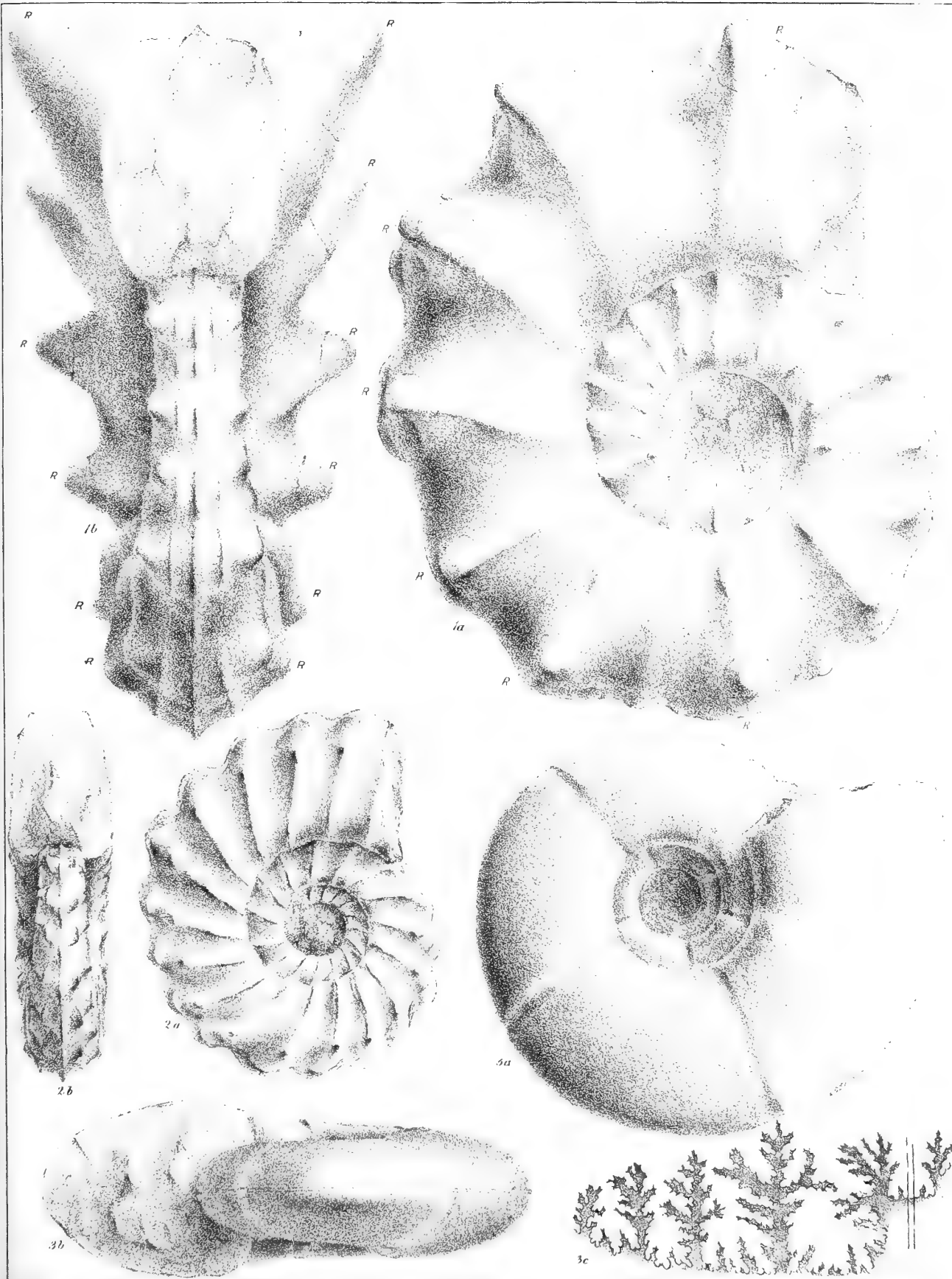


PLATE XII.

Fig.

- 1*a* and *b*. *AMMONITES AUSTENI*; reduced to one third its natural diameter; from the Grey Chalk of Guildford; in the British Museum.
2. *AMMONITES AUSTENI*; a young specimen, reduced to one half its diameter; from the Grey Chalk of Sussex; in the collection of Henry Catt, Esq.
3. *AMMONITES PLANULATUS*; from the Grey Chalk near Lewes; formerly in the collection of Dr. Mantell, and now in the British Museum; it is the original specimen figured in the 'Mineral Conchology;' the parts marked R are restored by the artist.
- 4*a*, *b*, and *c*. *AMMONITES PLANULATUS*; an internal cast from the Upper Green Sand near Cambridge; in the collection of Mr. L. Barrett.

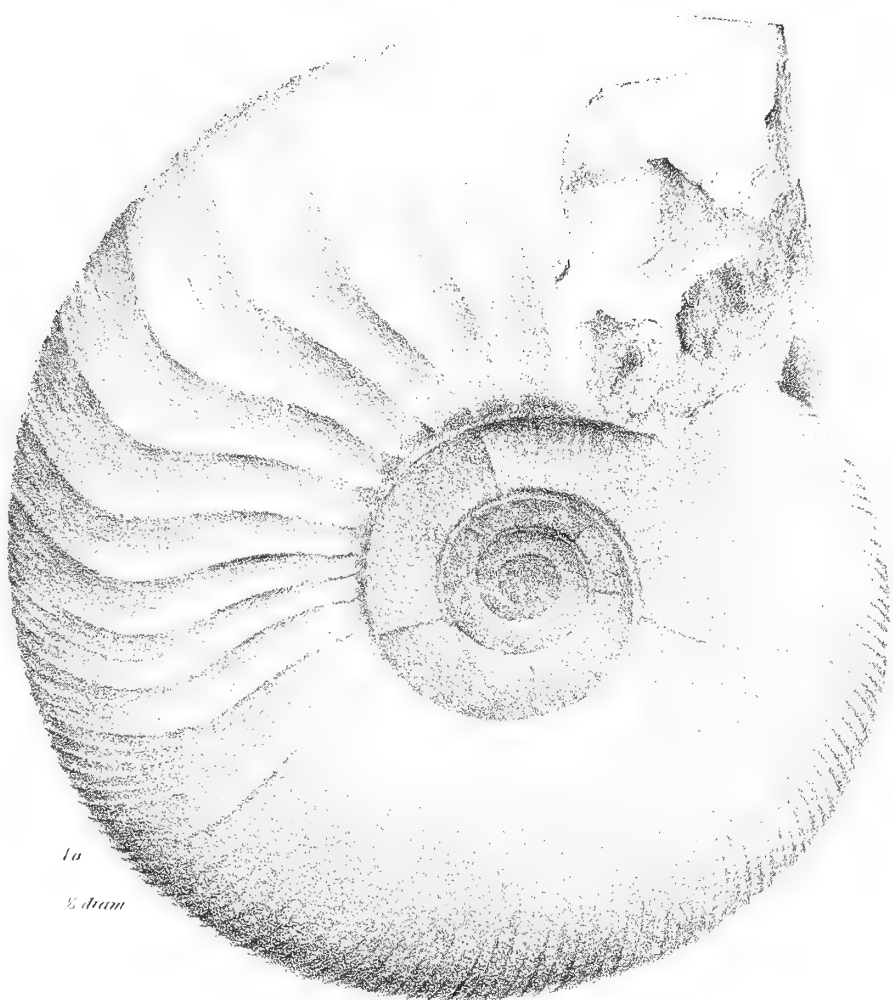
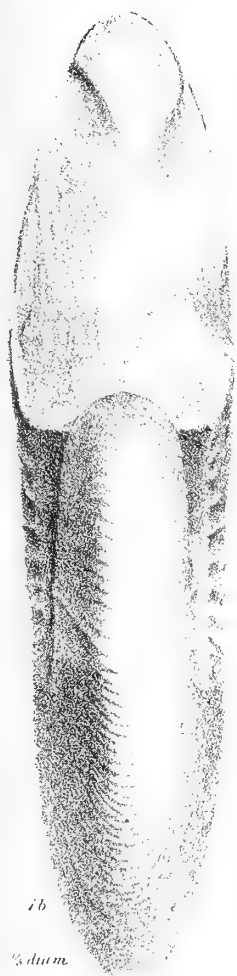


PLATE XIII.

Fig.

1*a* and *b*. *AMMONITES CATINUS*; reduced to one half its diameter; from the Grey Chalk near Devizes; in the collection of William Cunnington, Esq., of that town.

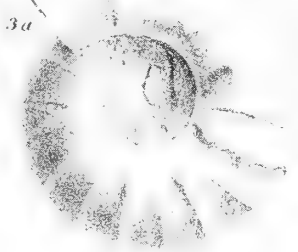
2 and 3*a*, *b*, *c*. *AMMONITES PORTLOCKI*; from the Hard Chalk of Tamlaght, in the County of Derry; in the Museum of Practical Geology, London.

4*a*, *b*, and *c*. *AMMONITES EUOMPHALUS*; from the base of the Lower Chalk at Man of War Cove, Dorsetshire; in the collection of E. H. Bunbury, Esq.



1a

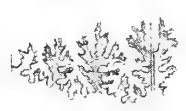
diam



3a



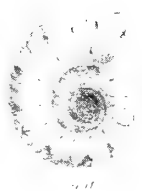
3b



3c



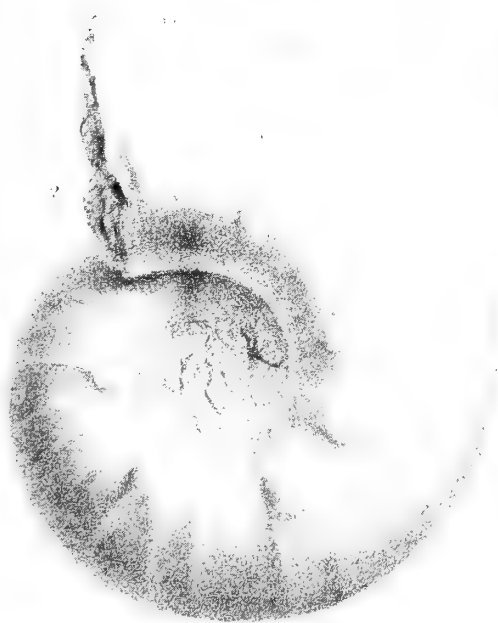
3d



4a



4b



1b
diam



PLATE XIV.

Fig.

1*a* and *b*. AMMONITES LATICLAVIUS; from the Grey Chalk of Bonchurch, in the Isle of Wight; in my possession.

2*a*, *b*, and *c*. AMMONITES OLDHAMI; from the Hard Chalk of Dungivan, in the County of Derry; in the Museum of Practical Geology, London. The surface of the original was waterworn, and has been a good deal restored in the drawing.

3*a* and *b*. AMMONITES LEPTONEMA; from the Grey Chalk of Ventnor, in the Isle of Wight; in my possession.

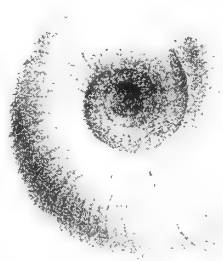
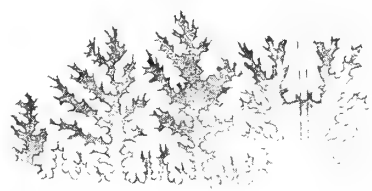
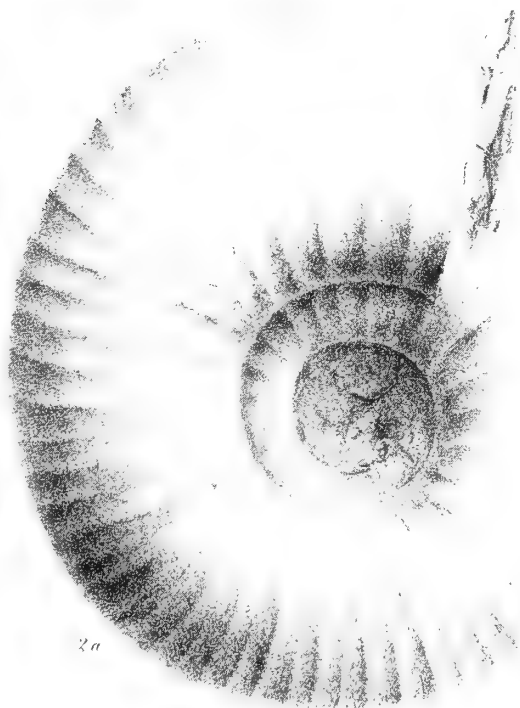
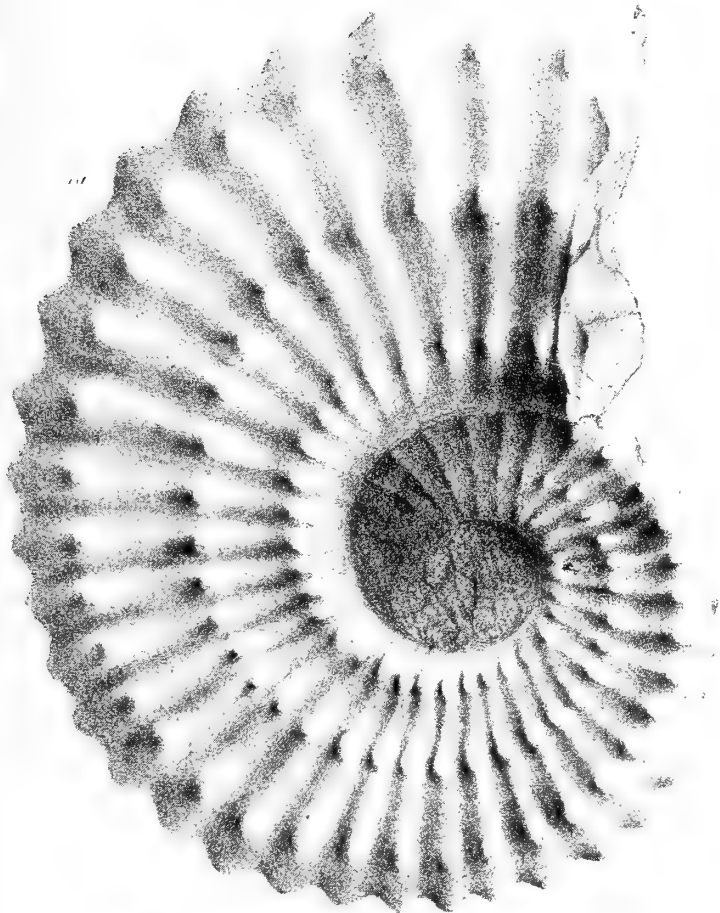
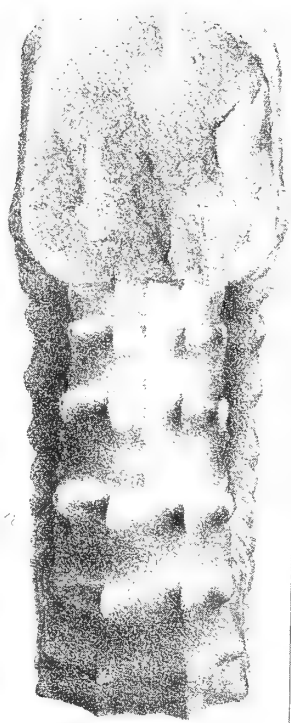
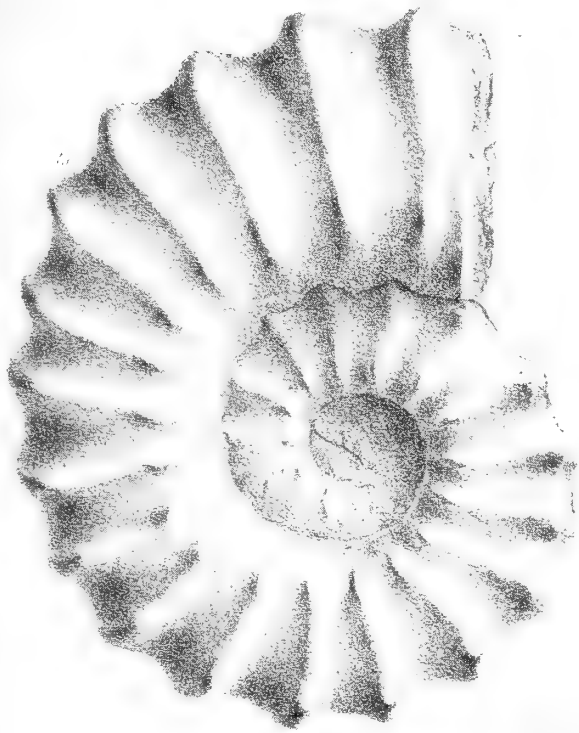


PLATE XV.

Fig

1*a*, *b*, *c*, and *d*. AMMONITES SUSSEXIENSIS ; a specimen given me by Dr. Mantell, from the Grey Chalk near Lewes ; reduced to two thirds its natural diameter.

2*a*, *b*, and *c*. AMMONITES CUNNINGTONI ; from a specimen belonging to T. A. Falkner, Esq., of Manningford, reduced to two thirds its natural diameter ; from the Grey Chalk of Upton Scudamore, near Warminster.



25 100

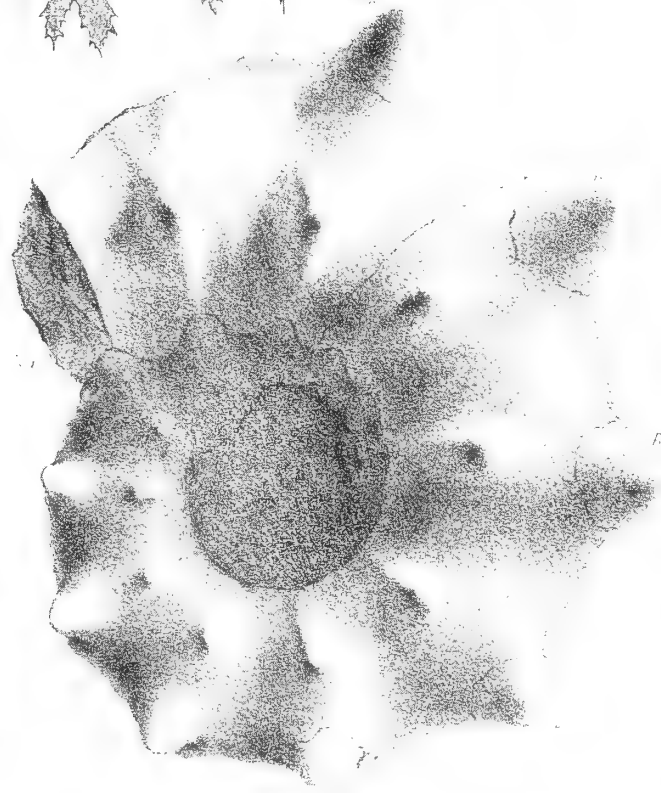


PLATE XVI.

Fig.

1*a*, *b*, and *c*. AMMONITES RHOTOMAGENSIS; from the Grey Chalk of Bonchurch, in the Isle of Wight; reduced to two thirds its natural diameter; in my possession.

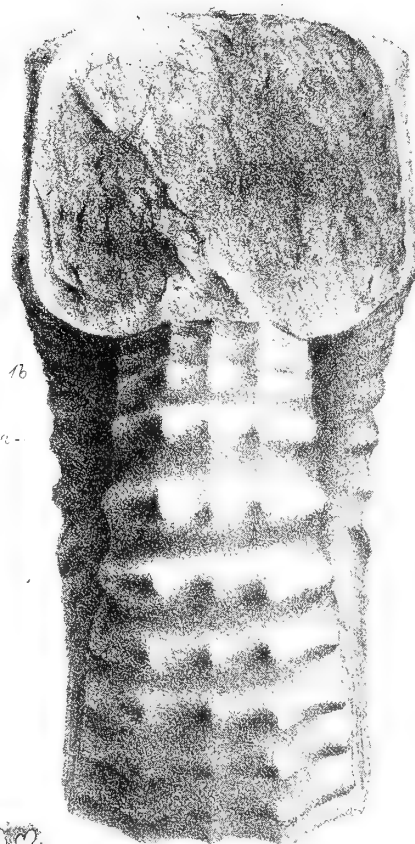
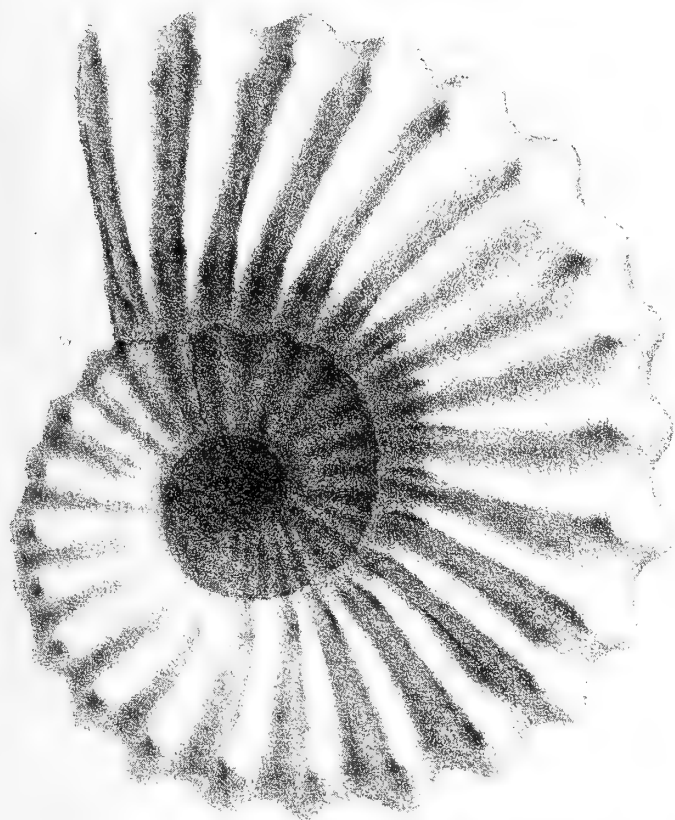
1*a* and 1*b*. Side and front views of the complete specimen.

1*c*. Inner whorl of the same specimen.

2*a* and *b*. AMMONITES RHOTOMAGENSIS; from the Grey Chalk of Bonchurch; of the natural size; in my possession.

3*a* and *b*. AMMONITES RHOTOMAGENSIS; a very young specimen, from the Grey Chalk of Bonchurch; in my possession.

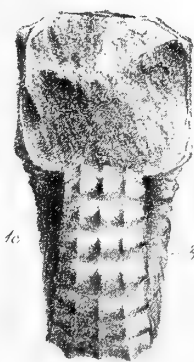
4. AMMONITES RHOTOMAGENSIS; outline of the septum of a specimen from the Grey Chalk near Lewes.



1b
23 diam.

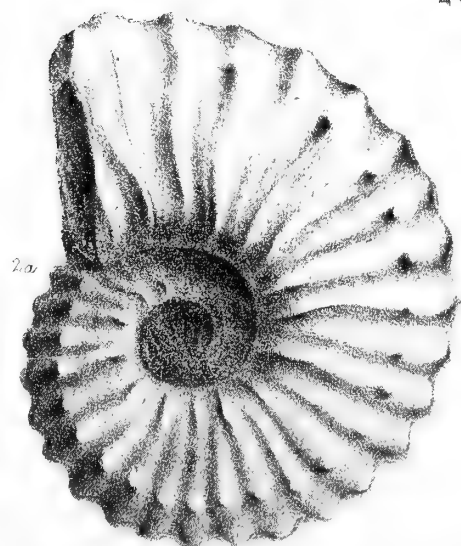


1

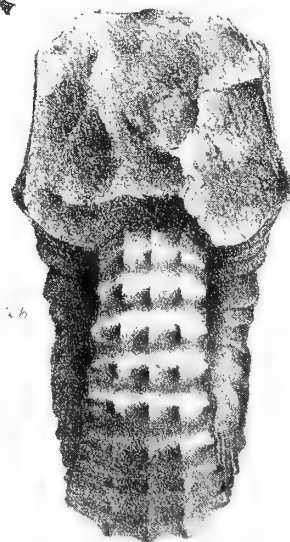


2a

23 diam.



2b



2c



2d



2e

THE
PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLIV.

A MONOGRAPH
OF
THE EOCENE MOLLUSCA,

OR
DESCRIPTIONS OF SHELLS FROM THE OLDER TERTIARIES
OF ENGLAND.

BY
FREDERIC E. EDWARDS.

PART III.
PROSOBRANCHIATA.

LONDON:
PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY
1854.

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CORRIGENDA.

In the head-lines to sheets 17, 18, and 19, (p. 129, *et seq.*), for "Pulmonata," read "Prosobranchiata."

Page 126, line 10, for "Cypræa," read "Cyprææ."

„ 133, „ 14, for "figs. 3 *a—d*," read "figs. 4 *a—c*."

„ 134, „ 27, for "Basingstoke," read "Cuffel, near Basingstoke."

„ 155, „ 28, for "(t. 25)," read "(t. 5.)"

„ 155, „ 30, after the word size, insert "axis, 1 in. and $\frac{4}{10}$ ths; diameter $\frac{6}{10}$ ths of an inch."

„ 158, „ 14, for "figs. 4 *a—c*," read "figs. 4 *a—d*."

„ 160, „ last line but one; after axis, insert "2 inches, nearly;" and after diameter, insert, "1 in. and $\frac{1}{10}$ th "

„ 168, „ 33, for "figs. 2 *a—b*," read "figs. 3 *a—b*."

ORDER—*PROSOBRANCHIATA*. M. EDWARDS.

PECTINIBRANCHIATA, *Cuvier*.
 TUBULIBRANCHIATA, „
 SCUTIBRANCHIATA, „
 CYCLOBRANCHIATA, „
 PARACEPHALOPHORA DIOICA, *De Blainville*.

To the free-air-breathing gasteropods succeed those which breathe, by means of gills, the air diffused through the water in which they livé. In them the head is more or less fully developed, and the mouth is furnished with a riband-shaped tongue, armed with numerous series of teeth, which present great varieties of form and arrangement. In some cases the animals are hermaphrodite, the sexes being united in the same individual, but in by far the larger proportion the sexes are distinct; with very few exceptions, they are all oviparous. In the larva state they are always furnished with spiral shells, which, in some cases, as the animals approach maturity, become rudimentary or altogether disappear; but more generally the shells become largely developed, so as to contain the whole animals within them. The respiratory organs exhibit many differences in structure and position, and these varied conditions were adopted by Cuvier as ordinal distinctions in the systematic arrangement proposed by him. De Blainville, on the other hand, availed himself of the modifications in the reproductive apparatus, and divided his second class "*paracephalophora*," into the sub-classes *dioica*, in which the male and female sexual organs are in different individuals, and *monoica*, in which the two sexes are united in the same individual. To these he added a third division, *hermaphrodita*, in which he described the generative apparatus as female only, a modification the existence of which subsequent investigation has disproved. It appears, however, by the observations of Milne Edwards, that the water-breathing gasteropods form two natural and well-defined divisions, which that eminent naturalist has called respectively, *opisthobranchiata* and *prosobranchiata*, from the position of the gills in relation to the heart.* In the first of these divisions, which corresponds with the *nudibranchiata*, *testibranchiata*, and *inferobranchiata* of Cuvier, and with the *monoica* and *hermaphrodita* of De Blainville, the respiration is effected by

* Etym. *οπισθε* (in the after part, behind), and *προωσον* vel *πρωσον* (advanced, pushed forward), respectively prefixed to *βραγχια* (the gills).

arborescent or fasciculated gills, which are not enclosed in a special cavity, but are more or less completely exposed, either on the back or on the sides towards the hinder part of the body. The reproductive apparatus is hermaphrodite (not in the sense used by De Blainville, but meaning that the sexes are united in the same individual), and the shell is either wanting or is merely rudimentary in the adult state. In the second division, the abdomen, which is developed proportionately with the cephalic and locomotive masses, is always protected by a shell, generally of sufficient size to contain the whole animal. The mantle forms over the cervical region a vaulted chamber, more or less capacious, in which the branchiæ are lodged and the excretory orifices are placed. The reproductive organs, male and female, are borne by different individuals. This division comprises Cuvier's four remaining orders of the *branchifera*, and corresponds with De Blainville's sub-class *dioica*. The branchiæ are composed of simple and parallel plates, arranged, somewhat like the teeth of a comb, along a vascular stem, and, for the most part, are placed obliquely across the back, or are attached to the right side of the neck.

In some genera in this order, the edge of the mantle is prolonged into a canal or siphon, which can be extended at pleasure, so as to permit the free passage of water into the branchial chamber, while the animal itself remains within the shell; and where this siphon exists, the front of the aperture of the shell presents a notch, or is produced into a channel in which the siphon rests. In other genera the respiratory siphon is altogether wanting, or its place is supplied by a lobe developed from the neck, and in these genera the aperture is without the anterior notch or channel. Sometimes a posterior tube exists with a corresponding notch or canal in the shell; but the function of this posterior tube is simply to provide for the more easy efflux of water or the ejection of the anal excretions from the branchial chamber. The head of the prosobranchiate gasteropod is provided with tentacles, which serve as organs of touch, and probably of smell, and with a proboscis which in some genera is retractile or exsertile. The eyes, with which organs all are endowed, are generally placed either at the bases, or on the extremities, or the sides of the tentacles; but in some genera they are carried on pedicels specially appropriated for them.

The presence or absence of the respiratory siphon has been used for the subdivision of the present order into two sections: 1st, *Siphonostomata*, corresponding with De Blainville's order *siphonobranchiata*, and comprising such of the prosobranchiata whose proboscis is retractile, and the margin of whose mantle is prolonged into a siphon, and whose shell is, consequently, notched or produced into a channel in front: and 2d, *Holostomata*, consisting of those in which the proboscis is not retractile, and the animal not being provided with a respiratory siphon, the aperture of the shell is entire. The genera comprised in the first section are all zoophagous, and are inhabitants of the sea or of brackish water; those in the 2d section are, for the most part, phytophagous; the greater number live in salt or brackish water; some, however, are inhabitants of fresh

water. This subdivision, although very convenient, is not, as Mr. Woodward* remarks, altogether satisfactory; inasmuch as several genera occur among the *holostomata* in which the proboscis is retractile, or the shells are notched or furnished with an anterior canal.

By far the greater part of the present order are furnished with an operculum, but many are without that protection.

Since Lovén published the result of his examination of the dental apparatus of Mollusca, much attention has been paid to the subject, and great importance is attached to the condition of the lingual teeth. But the assistance derived from this character, however valuable it may prove to malacologists, can be available indirectly only to the palæontologist.

Family—CYPRÆIDÆ.

Genus 20th. CYPRÆA.† *Linn.* 1740.

PERIBOLUS, *Adanson*, 1757; *De Blainville*, 1825.

CYPRÆA, *Lamarck*, 1801; *De Blainville*, 1825.

CYPRÆA, *Montf.*, 1810.

COCCINELLA, *Leach*, 1820.

TRIVIA—CYPROVULA—LUPONIA, *Gray*, 1830.

Gen. Char.—Shell oviform, oblong or sub-globular, convolute, enamelled, generally smooth, sometimes pustulous, transversely ribbed, or cancellated: spire short, depressed visible only in the young state, when adult, concealed by the enamel; aperture long, narrow, terminating at each extremity in a short canal; outer lip inflected, crenulated; inner lip crenulated.

The animal of Cypræa has a broad, sub-lunate head, terminating in a short retractile muzzle, and bearing long subulate tentacles on bulgings, at the outer bases of which the eyes are placed. The foot is broad, truncated in front, pointed, and sometimes much produced behind; the mantle terminates in a siphon in front, and the lateral margins, as the animal approaches maturity, expand into lobes, generally equal, but frequently more or less unequal, and which can be extended at pleasure, so as entirely or nearly to cover the shell, the edges meeting on the back or on the right side, according as the lobes are equal or unequal. By these lobes is deposited the testaceous matter which forms the enamel-like covering of the shell, characteristic of the family; the line of juncture being usually indicated, in recent cowries, by a groove or a streak of a fainter colour. The outer surfaces of the lobes are generally covered

* 'A Manual of the Mollusca,' p. 122.

† Etym., from *Cypris*, one of the names of Venus.

with filaments, sometimes with numerous papillæ, and in some instances they are smooth. The branchial organ consists of a single plume, and the dental apparatus is composed of a series of rows of teeth, each row formed of one broad uncinated central tooth, and three hooked lateral teeth on each side.

In the young state, the Cowry presents a very different appearance to that which it ultimately assumes. In the early stage of growth the outer lip is thin, sharp, and simple, neither involute nor crenulated; the aperture is wide and effuse in front, and the spire is well-marked. In this state the shell is quite smooth, and without the enamel and coloration which subsequently form its chief beauty.

Various generic divisions of the *Cypræa* have been proposed by different authors; but they appear to depend mainly on conchological distinctions, the animals, in so far as they are at present known, not presenting essential differences from the true *Cypræa*; and these genera, therefore, are more usually regarded as sections merely of the present genus. A slight variation in the dental apparatus, and the papillose surface of the lobes appear to distinguish the genus *Trivia*,* the only section of the present genus which is represented in our Eocene Fauna.

As a genus, the living Cowries have a wide range, extending from the shores of Greenland to the equator. The largest and most beautiful species are, however, inhabitants of the tropical seas, where they are found in shallows under coral-reefs or rocks. Upwards of 150 species have been figured and described; of these one species only (*Cyp. Europæa*), is found on our coasts.

In the fossil state, a few species, referred to this genus, from the upper cretaceous formations in Pondicherry, at Martignes (Bas du Rhone), and at Faxoë, in Denmark, have been described by Professor E. Forbes, Matheron, and Sir C. Lyell; but in the eocene and subsequent formations, the genus has a much larger development. From the lower and middle beds of the Paris Basin, twelve species have been described by Lamarck, Deshayes, and Melleville; from the miocene and more recent beds of Touraine, Dax, and Bourdeaux, and the pleiocene formations of Piedmont and Turin nearly seventy species have been described by Dujardin, Grateloup, Brocchi, Basterot, Sismonda, and others; and from the Crag of England, and the synchronous deposits in Belgium, several other species have been described by MM. Sowerby, Searles Wood, Nyst, and Philippi. Of the English eocene *Cyprææ*, five species only have hitherto been described; to these I now add four new species, three of which belong to the section *Trivia*.

No. 71. *CYPRÆA INFLATA*. Lamarck. Tab. XVI, fig. 4a, b.

CYPRÆA INFLATA, *Burtin*. 1784. *Oryct. de Bruxelles*, t. 17. fig. T.

— — *Lamk*. 1802. *Ann. du Mus.*, vol. ii, p. 389, No. 2, vol. vi, t. 44, fig. 1.

* Messrs. Adams' 'Genera of Recent Moll.,' vol. i, p. 264.

- CYPRÆA INFLATA, *Lamk.* 1822. Hist. nat., vol. vii, p. 407, No. 11.
 — — *Brogn.* 1823. Sur les terr. tert. &c. du Vicent. p. 62.
 — — *Defr.* 1826. Dict. des Sci. nat., vol. xliii, p. 35.
 — — *Bronn.* 1831. Ital. Tertiargeb. &c., p. 15, No. 33.
 — — *Gray.* 1832. (Add. to Mon. Cyp.). Zool. Journ., vol. iv, p. 76, No. 30.
 — — *Desh.* 1824—37. Desc. des Coq. foss., &c., vol. ii, p. 724; t. 97, figs. 7, 8.
 — — ? *Galeotti.* 1837. Mém. sur la const. géog. &c. de Brab., p. 148, No. 69.
 — OVIFORMIS, ? *Galeotti.* 1837. Mém. sur la const. géog. &c. de Brab., p. 183, No. 12.
 — INFLATA, ? *Nyst.* 1843. Coq. &c., de Belg., p. 607.
 — — *Sowerby.* 1850. Dixon's Geol. &c. Suss., p. 108, t. 8, figs. 4-5.

C. testá ovatá, inflatá, anticè attenuatá, posticè sub-obtusá, lævi: aperturá elongatá, angustá, flexuosá, basi dilatatá, vix emarginatá; columellá obsoletè plicato-dentatá; labro incrassato, extús sub-marginato, intus regulariter dentato, anticè compresso.

Shell ovate, ventricose, swelled out in the middle, attenuated in front, rather obtuse behind, smooth: aperture elongated, curved, narrow, but somewhat wider in front, where it terminates in a short wide canal, obscurely notched. The outer lip much produced, and the posterior extremity bent suddenly towards the apex of the spire, forming between it and the posterior extremity of the body-whorl, an oblique narrow groove, which represents the posterior canal found in some of the Cyprææ; the outer lip thickened, depressed on the surface, flattened in front on the inner surface, where it joins the anterior canal, and presenting a prominent ridge along the outer margin; the teeth, which are short and placed on the inner edge only, become obsolete on the flattened part of the lip. The columella presents four or five oblique folds in front, and is obscurely dentated behind.

This Cypræa occurs rather numerously in the *calcaire grossier*; our English specimens are generally of a larger size than those found in the French formations.

Size.—Axis, 1 inch and 5-10ths, nearly; diameter, 1 inch: occasionally larger specimens occur.

Localities.—Bracklesham Bay, where it is common; but the specimens are generally distorted. *French:* Grignon, Parnes, Mouchy, Amblainville, Thury-sous-Chaumont, (fide D'Orb.) The species is recorded by Brogniart and by Bronn as occurring at Ronca (Vicent.), but the identity is questionable. Casts of Cyprææ occur in the sands of Rouge-Cloître, St. Josse-ten Noode, Groenendael and Orp-le-Grand, in Belgium, which also have been referred, although with doubt, to the present species. The shells from Dax and St. Paul, which were described by Grateloup as belonging to *C. inflata*, appear to belong to a distinct species, which D'Orbigny has named *C. pseudo-inflata*; and the shells from the Piacentin, referred by Brocchi to this species, also appear to be distinct, and have been described by Sismonda under the name *C. labrosa*.

No. 71*. CYPRÆA OVIFORMIS. Sowerby. Tab. XVI, f. 1a—i.

CYPRÆA OVIFORMIS, Sow. 1812. Min. Con., vol. i, p. 17, t. 4, 3 lower fig.

— — Defr. 1826. Dict. des Sci. nat., vol. xliii, p. 40.

OVULUM RETUSUM, Sow. 1834. (Wetherellon Hampstead Heath Well,) Geol. Trans., 2d. Series, vol. v, p. 136, t. 8, fig. 19.

Non CYPRÆA OVIFORMIS, Galeotti. 1837. Mém. sur la const. géog. &c. de Brab., p. 183, No. 12.

C. testá sub-globosá, anticè attenuatá, lævi: aperturá posticè elongatá, flexuosá, angustissimá, anticè latiori, extremitatibus canaliculatá, ad basin emarginatá; labro posticè et in medio compresso et incrassato, anticè acuto, expanso, extus marginato, intus regulariter dentato; labio anticè compresso, in callum fastigiosum ad basin tendentem lateraliter expanso; columellá planulatá, anticè concavá, dentato-plicatá.

Shell sub-globose, narrowing gently towards the base, where it is produced into a short wide beak or canal, slightly notched in front, smooth: aperture elongated, curved, very narrow, but expanding a little before it enters the anterior canal; the outer lip prolonged at the posterior extremity, thickened; compressed until nearly opposite the wide part of the aperture, where it becomes thin and elevated, and is flattened on the inner surface; a narrow raised border, more or less prominent in different individuals, runs along the outer margin, and joins the thin elevated part of the lip. The teeth are numerous, short, not extending beyond the inner margin, and almost obsolete on the anterior part of the lip. The inner lip, towards the front, expands into a narrow ridge-like prominence, which extends to the very base; and at the posterior extremity rises into an angular callus, forming the left wall of the posterior canal. The columella is flattened, hollowed towards the front, and covered with numerous slender pliciform teeth.

The projecting margins, imparting to the front of the aperture the resemblance of a wide trough, form a character by no means common among the Cyprææ; it is found, although not so prominently, in *C. exerta* (Desh.), a species from the *sables inférieurs* of the Paris Basin, and in the English *C. Bartonensis*. A short and very globose variety (fig. 1d) occurs at Whetstone, in which the projecting margins are farther apart, and the trough, consequently, is wider than in the type. The specimen figured, which is from Mr. Wetherell's collection, has lost part of the anterior canal.

In the young state, this Cypræa is almost pyriform, being much more produced and attenuated in front; and it is covered with very numerous transverse raised lines, traversed by sharp, perspicuous lines of growth; the aperture is much lengthened and curved at the posterior extremity, wide, and very effuse in front, and the columella is twisted. In this state it has the appearance of an Ovula, and, in fact, an immature individual of the species obtained by Mr. Wetherell, from the well sunk at the Lower Heath, Hampstead, has been described by Mr. Sowerby as *Ovulum retusum*. A selection from the beautiful series of specimens in Mr. Wetherell's cabinet, with the aid of some

specimens in my own collection, enables me to show that the *Ovulum retusum* is, as I have stated, only the young shell of the present species. The shells represented by fig. 1e, 1f, and 1i, are young *Cyprææ*, in the first stage of growth, without teeth on either lip, and before the outer lip has become involute, but presenting the transverse lineation of the so-called *Ovulum retusum*, fig. 1i, being, in fact, taken from one of the original specimens so described. In the next specimen, fig. 1g, the shell has apparently attained the second or intermediate stage, the columellar teeth having been formed, and the lateral expansion of the left lip having commenced; and we find these characters associated with the transverse lineation. The specimen, fig. 1h, is a fully formed shell of *C. oviformis*, in which, a portion of the shell having been broken away, the interior volutions, exhibiting the transverse lineation, are disclosed.

Size.—Axis, 1 inch and 3-10ths; diameter, 1 inch.

Localities.—Primrose Hill, Highgate, Hampstead, Haverstock Hill, Copenhagen Fields; Barnet, Whetstone, Potter's Bar, Sheppey.

No. 72. *CYPRÆA BOWERBANKII*. Sowerby. Tab. XVII, fig. 1a—d.

CYPRÆA OVIFORMIS, Sow. (1812.) Min. Con., vol. i, p. 17; t. 4, upper fig.

— *BOWERBANKII*, Sow. (1850.) Dixon's Geol. &c., Suss., pp. 108 and 189, t. 8, figs. 1 and 2.

C. testá oviformi, ventricosá, lævi: aperturá angustá, arcuatá, anticè sub-effusá, latè emarginatá; labro inflexo, marginato, posticè producto, anticè compresso, dentato-plicato, dentibus anterioribus elongatis; columellá dentatá, dentibus anticis pliciformibus; denti primá magná, proeminenti, rotundatá.

Shell egg-shaped, ventricose, smooth: aperture curved, narrow, effuse in front, without a posterior canal, and widely but not deeply notched at the base; outer lip incurved, produced posteriorly, flattened towards the front; teeth on the flat part elongated, oblique; the anterior tooth on the columella large, round, prominent, and very oblique.

The specimen represented by fig. 1a and 1b, and for the use of which I am indebted to Mr. Sowerby, is the Highgate shell, from which the upper figure in tab. 4 of 'Mineral Conchology,' was taken; it has not attained maturity, the teeth not being formed on the outer lip. It will be seen that the aperture in fig. 1b is wider in front than that in fig. 1d, which is taken from a fully grown shell: this difference is to be attributed partly to the immature state of the outer lip of the specimen, and partly to the front of the columella being represented with a curve too deep. In other respects the Highgate shell agrees with those from Bracklesham Bay. The figs. 1c and 1d, are taken from specimens which form part of the late Mr. Dixon's collection.

According to the strict rules of nomenclature, the specific name *oviformis* ought, perhaps, to be retained for this shell; but the species which occurs not unfrequently at Highgate and the neighbouring localities, and which is figured on the same plate, is so generally known as *C. oviformis*, that I have applied the name to that species.

Size.—Axis, 3 inches and 1-10th; diameter, 2 inches and 2-10ths.

Localities.—Highgate, where it is very rare; Bracklesham Bay, where it is not uncommon.

No. 73. *CYPRÆA GLOBULARIS*. *F. E. Edwards*. Tab. XVI, fig. 3a, b.

CYPRÆA GLOBOSA, *J. Sow.* 1850. *Dixon's Geol., &c., Sussex*; p. 189, t. 8, fig. 3.

C. testá globosá, lævi, anticè rostratá, vix emarginatá; aperturá sub-rostrá, angustá, posticè sub-canaliculatá; labro inflexo, compresso, intús dentato, dentibus nebulosis, ferè equalibus; columellá dentato-plicatá, anticè compressá.

Shell globose, smooth, with a short, straight, rather narrow canal; scarcely notched in front; aperture nearly straight, narrow, terminating posteriorly in an obscure canal; outer lip broad, compressed, curved inwards, with numerous regular teeth, nearly equal in size, placed on the inner edge; columella furnished with numerous pliciform teeth.

The nearly globular form and short narrow beak of this exceedingly rare *Cypræa* distinguish it from all its congeners. The specimen from which the figures are taken forms part of Mr. Dixon's collection, and is, I believe, unique. The specific name proposed by Mr. Sowerby having been previously used by Dujardin for a different species from the Faluns of Touraine, I have substituted the present name for it.

Size.—Axis, nearly 2 inches; diameter, $1\frac{1}{2}$ inch.

Locality.—Bracklesham Bay.

No. 74. *CYPRÆA BARTONENSIS*. *F. E. Edwards*. Tab. XVII, fig. 6a—b.

C. testá ovatá, ventricosá, subtús depressiusculá, anticè attenuatá, lævi; spirá prominulá, vix obtectá, sulco obscuro circumdatá: aperturá lineari, angustissimá, anticè latiori, posticè elongatá, utrâque extremitate sub-rostratá et emarginatá; labro extus marginato, anticè compresso, regulariter dentato; columellá subrectá, planulatá, anticè concavá, dentato-plicatá, dentibus posticis elongatis.

Shell ovate, ventricose, flattened beneath, attenuated in front, rather obtuse behind; spire somewhat elevated, scarcely concealed by the enamel, and encircled by an obscure sulcus formed by the suture: mouth nearly straight, very narrow, a little wider in front, produced behind, and presenting at each extremity a short canal, slightly notched; outer lip broad, thickened, so as to form a curved raised border along the outer

margin, flattened towards the base, and furnished with numerous regular teeth, of which the posterior ones are pliciform. The anterior canal is defined by an obscure, nearly vertical plait on the outer lip, and a curved elevated plait at the base of the columella; inner lip thickened, and spread out at the base, forming a prominent callus towards the front of the whorl, plicated along the whole length on the inner margin, and produced at the posterior extremity into a bluntly pointed projection which forms the left wall of the posterior canal. Columella nearly straight, flattened, and presenting towards the front end, a deep three-sided concavity connected with the body whorl by a short, wide depression; columellar teeth pliciform, the posterior ones longer and more oblique than the others.

This species, the prettiest of the English Eocene cowries, resembles *C. media*, (Desh.) more closely, perhaps, than any other of the fossil Cyprææ; but the elevated spire, the anterior callus, and the strongly marked posterior canal impart to it a distinct character.

Size.—Axis, rather more than 1 inch: diameter, 7-10ths of an inch nearly.

Locality.—Barton, where it is not very common.

No. 75. CYPRÆA TUBERCULOSA. *Duclos*. Var. COOMBII. *Sowerby*. Tab. XVI, fig. 2, Tab. XVII, fig. 5.

OVULA TUBERCULOSA, *Duclos*.

CYPRÆA DESHAYESII, *Gray*. (1832). (Add. to Mon. Cypræ.,) Zool. Journ., vol. iv, p. 83, No. 64*.

— — *G. Sow.* (1832). (Notes on Gray's Additions to Mon. Cypræ.,) Zool. Journ., vol. iv, p. 221.

OVULA TUBERCULOSA, *Desh.* (1824-37). Desc. des coq. foss. &c., vol. ii, p. 717, t. 96, fig. 16, t. 97, fig. 17.

— — *Desh.* (1844). 2d edit. Lam. Hist. nat., vol. x, p. 478, No. 3.

CYPRÆA COOMBII, *J. Sow.* (1850). Dixon's Geol. &c., Sussex, pp. 108 and 188, t. 8, fig. 6.

OVULA TUBERCULOSA, *D'Orb.* (1852). Podrome de Paléont., vol. ii, p. 314, No. 297.

C. testá magná, trigoná, ventricosá, lævi, dorso aliquando tuberculatá, subtus planulatá: aperturá elongatá, angustissimá, ferè edentulá, arcuatá, anticè latiori, utrâque extremitate canaliculatá; canali posteriori ad spiram reflexo, canali anteriori recto: labro compresso posticè exserto, sub-auriculiformi, lateraliter expanso.

Shell large, trigonal, ventricose, smooth, sometimes presenting one or two tubercles on the back; base flattened, posterior end very broad, flattened, almost truncated: aperture elongated, curved, very narrow, rather wider in front, nearly if not altogether toothless, with a wide canal at each extremity; the anterior canal straight, the posterior one curved and bent upwards towards the spire; outer lip broad-edged, expanding at the posterior extremity into an ear-shaped projection.

The French specimens of the *Cypræa tuberculosa* are smaller and less triangular in form than our English shells; and the flattened posterior extremity is circumscribed by two lateral callosities which rise, one on each side, towards the back. This singular character, which forms a prominent feature in the specimen figured by M. Deshayes, and which I am assured by that gentleman is constant in the French shells, is wanting in the very few English specimens I have seen. Notwithstanding these differences, the English shells present such close affinities to the French specimens, that they must be regarded rather as a strongly marked local variety than as a distinct species. The dorsal tubercles, from which the specific name is taken, are stated by Mr. Sowerby not to be a constant character; they certainly appear to vary much in size and position, for in the figure and description given by M. Deshayes they are represented as of considerable size, and as ranged longitudinally about the middle of the shell; while in Duclos's original figure, they appear to be much smaller, and are placed transversely near the posterior extremity. The English specimen now figured, presents an even surface; but one, formerly in Mr. Bowerbank's museum, and which, unfortunately, has fallen to pieces, had a single large tubercle near the middle.

With regard to the genus to which this singular shell should be referred, a difference of opinion exists. The absence, or nearly obsolete condition, of the columellar teeth would seem to require that it should be placed, as in fact all the French authors have placed it, among the *Ovulæ*; but the pyriform shape, the aperture, and the general aspect of the shell belong rather to *Cypræa*. Dr. Gray has pointed out the analogy between it and the tuberculated variety of the recent *C. mus*, and asserting in fact, that M. Deshayes's specimen has a very few obscure teeth on the lips, he has stated that, in his opinion, the shell is evidently a cowry, an opinion from which Mr. George Sowerby has not dissented. On this authority, I have retained the shell in the present genus, of which, as Mr. James Sowerby has suggested, it may form with *C. mus*, a sub-genus.

Size.—Axis, 6 inches and 6-10ths; diameter, 5 inches.

Localities.—Bracklesham Bay, where it is rare. *French*: Rétheuil, Cuise-Lamotte, Pierrefonds, (Oise), (fide D'Orb).

Section—TRIVIA.

No. 76. *CYPRÆA PLATYSTOMA*. *F. E. Edwards*. Tab. XVII, fig. 7a—f.

C. testá parvá, ovato-oblongá, ventricosá, anticè attenuatá, transversim lineatá, apice elevato; lineis angulosis, numerosis, regularibus, sulco dorsali perspicuo, mediano, interruptis; spatiis inter lineas concavis; aperturá latá, posticè sub-productá, flexuosá, canaliculatá, anticè brevi latoque canali exeunti, vix emarginatá; labro extús late marginato, in medio leviter arcuato.

Shell small, ovately oblong, ventricose, attenuated in front, almost pyriform; trans-

versely ridged; apex elevated; ridges slender, sharp-edged, numerous, (18 to 20), regular, interrupted by a dorsal sulcus; the spaces between the ridges regularly concave; aperture wide, with parallel margins, somewhat produced and curved behind, terminating in a short, wide canal, and slightly notched in front; the outer lip, towards the middle, is curved correspondingly with the shape of the body-whorl, and presents a wide but not much raised border along the outer edge. The dorsal sulcus, which is very distinct, becomes wider and deeper at each extremity. The transverse ridges are more numerous on the right lip than across the back, as several short ones rise out of the aperture, which scarcely extend beyond the outer margin. In the young shell, (fig. 7a—c), the right lip is obscurely dentated towards the front, but is otherwise smooth; it presents a raised border along the outer edge.

Size.—Axis rather more than 4-10ths of an inch; diameter, 3-10ths of an inch.

Localities.—Highcliff, and Alum Bay: (Strat. No 29, Prestwick).

No. 77. *CYPRÆA WETHERELLII*. *F. E. Edwards*. Tab. XVII, fig. 3a—d.

CYPRÆA PEDICULUS? *Webst.* (Observations on the strata over the Chalk, &c.,) *Geol. Trans.*, 1st Ser., vol. ii, p. 204.

C. testā parvā, sub-globosā, transversim lineatā; lineis tenuibus, numerosis; sulco dorsali vix conspicuo non interruptis; aperturā sub-medianā, leviter arcuatā, posticè productā, sub-canaliculatā.

Shell small, nearly globose, slightly attenuated in front, transversely ridged; ridges thin, angular, not interrupted by the obscure dorsal sulcus, few in number as they emerge from the aperture, but becoming numerous by the bifurcation of some, and by the appearance of new ridges between others; aperture nearly central, narrow? slightly curved, produced behind, forming a short wide canal; outer lip ?

The specimen of this *Cypræa* from which the description and figure are taken is imperfect; the outer lip and the front of the columella are both broken, and the shelly matter on part of the back is decomposed, exposing a cast in the pyrites with which the interior of the shell is filled; but the posterior extremity of the outer lip and the triangular elevation which formed the left wall of the posterior canal remain. The continuation of the transverse ridges across the back of the shell, uninterrupted by the dorsal sulcus, is plainly shown.

This *Cypræa* is one of the many additions to our Eocene Fauna for which we are indebted to the indefatigable zeal of Mr. Wetherell, with whose name I designate the species. The specimen from which the figures are taken, was found in one of the cuttings made at Whetstone, on the formation of the Great Northern Railway. Another, and apparently a younger, specimen was also obtained by Mr. Wetherell from the railway cutting at Primrose hill.

Among the fossil Cyprææ found in the Paris basin, is one belonging to the present section, which Lamarck considered to be identical with the recent *Cyp. pediculus*, but which, M. Deshayes, in his 'Description des coquilles fossiles,' &c., has shown to be distinct, and has named *C. Lamarckii*. Mr. Webster (*loc. cit.*) has recorded a fossil cowry as occurring at Highgate, and at Stubbington, which he also refers to *C. pediculus*. I have not met with any Cypræa belonging to this section, either from Stubbington or Bracklesham Bay; but it is not improbable that the Highgate specimen mentioned by Mr. Webster belonged to the present species, which, however, is more globose than *C. Lamarckii*, with a wider aperture, and more numerous transverse lines.

Size.—Axis, rather more than 3-10ths of an inch; diameter, 3-10ths of an inch.

Localities.—Whetstone, near Barnet; Primrose-hill.

NO. 78. CYPRÆA PRESTWICHII. *F. E. Edwards*. Tab. XVII, fig. 2a—c.

C. testá parvá, ovato-oblongá, ventricosá, anticè attenuatá, canaliculatá, víx emarginatá, transversim lineatá; lineis numerosis, tenuibus, irregularibus, sulco dorsali, sub-mediano, obscuro, interruptis; aperturá angustá, lineari; labro involuto.

Shell small, ovately oblong, ventricose, attenuated towards the anterior extremity, with a short canal, slightly notched in front, and covered with transverse ridges, interrupted on the back by an obscure, nearly medial sulcus; ridges slender, sharp-edged, numerous (18 to 20), irregular; aperture linear, narrow; outer lip incurved.

This Cypræa is not so pyriform as *C. platystoma*; the apex is not so elevated, the transverse ridges are less regular and not so numerous, particularly over the outer lip; and the aperture is linear without any posterior curve. The more globose form, the elongated aperture, and the posterior canal of *C. Wetherelli*, distinguish it from that species.

I am indebted for this cowry to Mr. Prestwich, to whom I have dedicated it.

Size.—Axis, rather more than $\frac{1}{4}$ of an inch; diameter, 2-10ths of an inch.

Locality.—Basingstoke.

Genus 21st.

AMPHIPER
LICIUM, *H*
CYPHOMA, .
OVULA, *Lan*
OVULUS, *Mc*
CALPURNUS,
ULTIMUS, *Mc*

SCYMNIA, *Leach*, 1819.

SIMNIA, *Risso*, 1826.

CALPURNIA, *Fleming*, 1828.

VOLVA, *Fleming*, 1828.

CYPRÆLLA, *Swainson*, 1840.

CARINEA, *Swainson*, 1840.

Sect. VOLVA, *Bolten*, 1798.

RADIUS, *Montf.*, 1810.

RADIUS, *Schum.*, 1817.

BIROSTRA, *Swainson*, 1840.

Gen. Char.—Shell ovate, gibbous, more or less attenuated or produced, and emarginate at each extremity; smooth, convolute upon a nearly horizontal plane; spire concealed: aperture longitudinal, elongated, narrow behind, more expanded in front; outer lip generally inflected, thickened, denticulated; inner lip smooth.

The Ovulæ present great similarities to the Cyprææ, both in the organization of the animal and the construction of the shell. The principal distinctions between the animals appear to be in the condition of the muzzle, and in the mantle, the surface of which, in the true Ovulæ, is always smooth. The shells are distinguished by the absence of teeth on the left margin of the aperture, and by the prolongation of the two extremities; but, like the Cowries, they are, when fully formed, smooth and polished, owing to the enamel-like coating secreted by the extended margins of the mantle.

The genus was first separated by Gronovius, under the name *Amphiperas*, and was afterwards defined by Bruguière under the present name, by which it has been generally received. Several dismemberments have been proposed by Bolten, Fleming, Leach, Swainson, and others, on conchological distinctions only. In one of these, the genus *Volva* proposed by Bolten for the well-known oriental shell, called the “weaver’s shuttle,” (*Ovula volva*), the animal, according to Mr. Adams,* presents certain peculiarities, consisting of a row of nipple-like tubercles along the edge of the mantle, and of a narrow foot folded longitudinally and adapted for crawling upon the round slender stems of the Gorgoniæ and other zoophytes on which the animal feeds, which modifications appear to confirm the separation; but the other proposed divisions are for the present received as sections only of the present genus until more accurate knowledge of the anatomy and habits of the animals is acquired.

The living *Ovulæ* are not very numerous. and are, for the most part, inhabitants of warm climates; they are found principally in the seas of China, Western America, and the West Indies; one species only is found on our own shores. The fossil *Ovulæ* are very few; seven species from the cretaceous formations, five of which were described as *Cyprææ*, are referred by D’Orbigny to this genus; two species, exclusive of *O. (Cypræa) tuberculosa*, before described, occur in the Eocene tertiaries of France, and three are found in the more recent formations.

* ‘Zoology of the Voyage of H. M. S. *Samarang*,’ p. 19.

No. 79. OVULA? ANTIQUA. *F. E. Edwards.* Tab. XVII, fig. 3a—b.

O. testá elongato-ovali, sub-ventricosá, posticè sub-acuminatá, lævi : aperturá angustá, posticè elongatá, in canali brevi, mediocriter lato, exeunti, anticè effusá.

Shell of a lengthened oval form, somewhat ventricose in the middle, slightly acuminate at the posterior extremity, smooth: aperture elongated, narrow behind; posterior canal short, moderately wide. The anterior extremity is broken; it appears to have been rather more obtuse than the posterior one. The last volution is smooth, but the surface of the preceding volution presents numerous transverse striæ, perspicuous towards the posterior extremity, and becoming obsolete as they approach the middle of the whorl; these striæ are very fine, so much so as to be barely perceptible by the naked eye.

The only specimen I have seen forms part of Mr. Wetherell's collection; it is too imperfect for a detailed description, or even for ascertaining satisfactorily the genus to which it belongs. It is apparently an immature shell just emerging from the first stage of growth before the outer lip has become thickened or involute, and when the absence of teeth on the columella is not conclusive of the genus. It may be the young shell of a *Cypræa*, resembling the *C. acuminata* of Melleville, and, therefore, I have referred it to the present genus with doubt, and have named it provisionally only.

Size.—Axis, $\frac{1}{2}$ an inch; diameter, 2-10ths of an inch.

Locality.—Primrose Hill.

Genus 22d. MARGINELLA.* *Lamarck.*

PORCELLANA, PERIBOLUS, *Adanson*, 1757.

DACTYLUS, *Humphrey*, 1797.

MARGINELLA, *Lamarck*, 1801.

MARGINELLUS, *Montfort*, 1810.

PERSICULA, *Schum.*, 1817.

VOLVARIA, (sp.) *Lamarck*, 1822.

MARGINELLA, GLABELLA, } *Swainson*, 1840.

VOLUTELLA, GIBBERULA, }

PHÆNOSPIRA, CRYPTOSPIRA, *Hinds*, 1844.

Gen. Char.—Shell oval, oblong, smooth, enamelled; spire short, sometimes almost concealed: aperture elongate, narrow, truncate, sometimes broadly but not deeply notched in front; outer lip thickened externally, inner margin sometimes smooth, generally crenated; columella with distinct plaits, more or less numerous.

* Etym., Diminutive of *Margo*, a rim or margin.

This genus was first separated by Adanson, and afterwards by Humphrey, for shells previously referred either to *Voluta* or *Mitra*. Subsequently Lamarck defined it more exactly under the present name, by which it is now known. The animal resembles that of *Cypræa* in all essential particulars, and like it, is furnished with lobes to the mantle, which can be extended over the shell so as to cover the spire, which thus acquires an enamel-like covering resembling that of the Cowries. The condition of the spire, the number and the arrangement of the columellar plaits, and the simple or crenated state of the outer lip, have been used as characters for the separation of the *Marginellæ* into various genera; but these divisions do not appear to be warranted by generic distinctions in the animals and consequently, have not been generally adopted, but have been regarded as sections merely of the present genus. Mr. G. Sowerby (*Gen. Shells*), has suggested that the *Marginellæ* may be classed under two natural sections; the first comprising the species in which the spire is distinct, the columella furnished with four folds at the base, and the outer lip characterised by a thick fold-like border along the outer margin; the other consisting of the species in which the spire is short, almost concealed, the columellar plaits more numerous, the anterior plaits being the larger, and the outer lip but slightly thickened. The first section corresponds with *Glabella* (Swain.) and *Phænospira* (Hinds); the latter represents *Persicula* (Schum.), *Volutella*, *Gibberula*, *Marginella* (Swain.), and *Cryptospira* (Hinds).

The recent *Marginellæ* are numerous; they chiefly inhabit the tropical and sub-tropical seas, where they are found in shallow waters; they appear to abound on the coasts of Africa, and some few small species, belonging to the second section, are found in the Mediterranean. In the fossil state they first appear during the tertiary epoch. In the French eocene beds, eleven species occur, of which seven have been described by Lamarck and Deshayes; and of these, several are found in England, Germany, and Belgium. Six species from the corresponding formations in Alabama (U.S.), have also been described by Conrad and Lea: and in the more recent deposits in Europe and the United States, twenty additional species have been found.

Section A. Spire apparent.

No. 80. MARGINELLA EBURNEA. *Lamarck*. Tab. XVIII, figs. 1 *a—c*.

MARGINELLA EBURNEA, *Lamk.* 1803. Ann. du Mus., vol. ii, p. 61, No. 1; and vol. vi, t. 44, fig. 9.

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| — | — | <i>Roissy.</i> 1804. Buff. Moll., vol. vi, p. 9, No. 4. |
| — | — | <i>Lamk.</i> 1822. Hist. nat., vol. vii, p. 359, No. 15. |
| — | — | <i>Brogn.</i> 1823. Sur les ter. tert., du Vicent., p. 64, No. 1. |
| — | — | <i>Defr.</i> 1823. Dict. des sci. nat., vol. xxix, p. 145. |

MARGINELLA EBURNEA,	Desh.	1830.	En. Méth. (Vers), vol. ii, p. 413, No. 13.
—	—	Bronn.	1831. Ital. Tertiärggeb., p. 18, No. 53.
—	—	Desh.	1824-37. Descr. des coq. foss., &c., vol. ii, p. 707, t. 95, figs. 14—16, and 20—22.
—	—	J. Sow.	1850. Dixon's Geol., &c., of Suss., p. 107.
—	—	? Phil.	1851. Palæontographica (Tert. Foss. Magd.), vol. i, p. 79, No. 174.
—	—	? Beyrich.	1853. Die Conchyl. des Norddeutschen tert., vol. i, p. 52, t. 2, figs. 9 a, b.
Nec. —	—	Grat.	1838. Cat. Zool., &c., de la Gironde, p. 50, No. 478.
nec. —	—	Grat.	1845. Conch. foss., &c., de l'Adour, t. 1, (Tarrière, &c.,) figs. 38—40.
nec. —	—	Sismon.	1847. Syn. meth., &c., Pedemont. Foss., p. 42, No. 46.

M. testâ parvâ, ovato-elongatâ: spirâ acuminatâ, ultimo anfractu breviori; anfractibus convexiusculis, ad suturam confluentibus; aperturâ angustâ; labro posticè sinuato, extus marginato, intus mutico; columellâ quadriplicatâ.

Shell small, elongated, with an elevated pointed spire, rather shorter than the aperture, and formed of five or six narrow, slightly convex whorls, somewhat depressed round the sutural margin, the sutures concealed by the enamel; body-whorl conoidal; aperture elongated, narrow, obscurely notched in front; lips nearly parallel; outer lip with a wide and moderately deep sinus at the suture, thickened and presenting a raised border along the outside margin, smooth within; columella nearly straight, and furnished with four narrow, almost equal folds, the front two of which are more oblique than the others.

M. Deshayes, when he separated *M. hordeola*, suggested at the same time that it might be only a variety of the present species; Dr. Beyrich in fact maintains the identity, and that the only distinction is the difference of size. I do not concur in this opinion. Both species belong to a group, in several of which the characters depend, to a great extent, on the condition of the aperture and the general form of the shell; characters in some instances difficult to define, but which strike the eye forcibly, and from their constancy acquire specific importance. The general form of the shell in *M. hordeola* is not so broad as that of *M. eburnea*, owing to the whorls being less convex; the spire is more obtuse, and comparatively shorter; and the aperture is longer and narrower, particularly at the posterior extremity, and it is more contracted at the middle in consequence of the greater involution of the outer lip. Other species occur in the *calcaire grossier*, belonging to this group, and hitherto undescribed, but which, as I learn from M. Deshayes, will be described in the forthcoming supplement to his 'Description des coquilles fossiles,' &c. One of these (*M. contabulata*), appears to be intermediate in size between *M. eburnea* and *M. hordeola*, and, in fact, to present a close general resemblance to the former. It is unnecessary to enter upon any examination

of the characters distinguishing this new species; but it is not improbable that Dr. Beyrich may have associated specimens of *M. contabulata* with the true *M. hordeola*.

It is always hazardous, without the assistance to be derived from actual specimens, to express an opinion on questions of identity; but the figure given by Dr. Beyrich does not convey to my mind an idea of *M. eburnea*; the spire seems to be shorter and thicker, the apex to be more obtuse; the aperture to be shorter, less wide in front, less narrow behind; the outer lip is represented without the posterior sinus, and the folds on the columella appear to be more oblique. The figure agrees much better with *M. contabulata*, to which species, if it had been published, the German shell would more probably have been referred.

The present species appears to be confined to the older tertiary formations; the shells from Dax, and the neighbourhood of Bourdeaux, referred to it by Grateloup, belong to a different species, which D'Orbigny has named *M. sub-eburnea*; as do those from Turin, described by Sismonda, and to which Michelotti has given the name, *M. Taurinensis*.

Size, of the specimen figured, which forms part of Mr. D'Urban's collection, is, axis, 3-10ths of an inch; diameter, half the length of the axis. The French specimens are frequently much larger.

Localities.—Bracklesham Bay, where it is very rare. *French*: Grignon, Parnes, Courtagnon, Ermenonville, Azy, le Tombray (fide D'Orb.). *Italian*: Ronca, Val Sangonini (fide Brogn.) *German*: Osterweddingen in Magdeburg? (fide Beyrich.)

No. 81. *MARGINELLA BIFIDO-PLICATA*. Charlesworth. Tab. XVIII, figs. 2 a—g.

M. testá minimá, ovato-globosá, ad basin vix emarginatá; spirá conicá, brevi, apice sub-obtusó; anfractibus convexis: aperturá angustá, longitudine spiram paulo superanti; labro crassissimo, compresso, extús marginato, intús acuto, posticè profundè emarginato; columellá quadriplicatá, plicis tribus posticis bifidis, pene transversis; plicá anteriori acutá, obliquá.

Shell very small, roundedly ovate, with a short, conical spire and a bluntish apex: aperture narrow, a little longer than the spire, with the margins nearly parallel: outer lip much thickened, presenting a prominent border along the outer margin, a sharp edge inwards, and a deep sinus near the suture; columella with four folds, of which the anterior one is sharp and very oblique, and the remaining three thick, bifid, and nearly transverse.

This marginella approaches very closely to a species from the Paris Basin, not yet described, but to which M. Deshayes has given the name *M. columbellina*, and a comparison with a longer series of that species than I possess, may eventually establish the identity. It appears, however, to be a broader and more ventricose shell, having a

shorter spire and a narrower aperture than *M. columbellina*, and the columellar plaits are more strongly bifid than in that species. The outer lip in the adult shell also is flattened in front, and its inner margin presents a sharp edge; whereas in the French species the outer lip is rounded and rather involute. I must state that in the young shell, the columellar plaits in *M. bifido-plicata* are thin and simple, and that the bifid character is assumed only at maturity.

The other species from the *calcaire grossier* (*M. contabulata*), to which I have before referred, appears to be a longer and narrower shell than the present one; the whorls are distinct, notwithstanding the enamel, and present an obscure channel running round the suture; the mouth is more effuse in front, the outer lip not so much thickened, the posterior sinus obscure, and the columellar plaits more oblique.

The present species is found in profusion in the Highcliff sands; and sparingly in the Barton Beds. Specimens are also found, rather plentifully, in the corresponding stratum (No. 29, of Mr. Prestwich), in Alum Bay, larger and more regular in form and with a somewhat longer spire than the type, but agreeing with it in all essential characters (figs. 2 *e—g*), and I consider the last, therefore, to be merely a local variety. It also occurs in the stratum No. 4, Prestwich, in Alum Bay, and at Bracklesham Bay. The specific name is taken from the bifid condition of the columellar plaits, a character found, however, in several other species belonging to this group, although not so strongly marked as in the present one; it was proposed by Mr. Charlesworth, in a lithographic print of the species forming part of a series of figures of shells from Highcliff and Barton, beautifully executed, under the direction of that gentleman, for distribution among the members of the "Natural History Society."

Size.—Type, Axis, somewhat less than 2-10ths of an inch; diameter, 1-10th of an inch.

No. 82. *MARGINELLA GRACILIS*. *F. E. Edwards*. Tab. XVIII, figs. 4 *a—c*.

M. testá minimá, tenui, subfusiformi, ad basin vix emarginatá; spirá elevatá, conicá, apice obtuso: anfractibus quinque, convexis: aperturá elongato-ovali, in longitudine spiram superanti, postice obscurè canaliculatá; labro incrassato, extus marginato; columellá quadriplicatá, plicis tribus posticis obliquis, bifidis.

Shell very small, slender, tapering nearly equally towards each extremity; spire elevated, conical, with an obtuse apex; whorls five, convex, the last whorl scarcely notched at the base: aperture of a lengthened oval shape, moderately wide, and rather longer than the spire; outer lip thickened within, and presenting a narrow, slightly raised border along the outer margin, and a small obscure channel at the suture; columella with four folds, of which the posterior three are bifid, and rather oblique.

This may be merely a variety or an immature state of *M. bifido-plicata*, and, as I have only two specimens before me, I have separated it with much hesitation. The

shell is, however, narrower and slenderer, somewhat resembling *M. hordeola* in shape, but more regularly fusiform. One of the specimens has the outer lip thickened and margined, and it appears therefore, to have attained maturity; but the posterior sinus characteristic of this group and which is so strongly marked in *M. bifido-plicata*, is wanting, and is represented by an obscure, scarcely perceptible channel at the suture. The lip itself is not involute as in *M. hordeola*, but is simply thickened, and the front is round, not flattened, as in *M. bifido-plicata*.

The specimen figured is from Mr. D'Urban's cabinet.

Size.—Axis, 2-10ths of an inch; diameter, rather less than 1-10th of an inch.

Locality.—Barton, where it is scarce.

Marginella dentifera. (Lamarck.) This species is recorded in the list of "The Fossils of Bracklesham and Selsey," published in Mr. Dixon's '*Geology, &c., of Sussex*,' p. 107, on the authority of a specimen which formed part of my collection, but which, unfortunately, has been broken: I am not aware that any other individual has been found. The species is very rare in France; and as Mr. Sowerby, by whom the list was prepared, did not himself see the specimen, the identification cannot be relied on; I have therefore not included *M. dentifera* among the English eocene Marginellæ.

Section B. Spire concealed or nearly so.

No. 83. MARGINELLA OVULATA. Lamarck. Tab. XVIII, figs. 5 a—c.

MARGINELLA OVULATA, *Lamk.* 1803. Ann. du Mus., vol. ii, p. 61; vol. vi, t. 44, fig. 10.

— — *Roissy.* 1804. Buff. Moll., vol. vi, p. 10, No. 6.

— — *Lamk.* 1822. Hist. nat., vol. vii, p. 359, No 17.

— — *Defr.* 1823. Dict. des sci. nat., vol. xxix, p. 145.

— — *Desh.* 1824-37. Desc. des coq. foss., &c., vol. ii, p. 707, t. 94 bis, figs. 27—29.

— — *Desh.* 1830. Enc. méth. (Vers), vol. ii, p. 416, No. 20.

— — *Bronn.* 1831. Ital. Tertiärgeb., p. 18, No. 52.

— — *Bronn.* 1838. Leth. geog., p. 1106, t. 42, fig. 44.

— — *J. Sow.* 1850. Dixon's Geol., &c., of Sussex, p. 107, t. 7, fig. 38.

— — ? *Beyrich.* 1853. Die Conchylien des Norddeutschen tert., vol. i, p. 49, t. 2, fig. 10a—b.

MILIACEA? *Philippi.* 1851. Palæontographica (Tert. foss. Magd.), vol. i, p. 79, No. 177.

Nec. — OVULATA, *Grat.* 1838. Cat. Zool., &c., de la Gironde, p. 50, No 481.

nec. — — *Grat.* 1845. Conchy. foss., &c., de l'Adour, t. 1, fig. 35.

nec. — — *Sism.* 1847. Syn. meth., &c., Pedemont. foss., p. 46.

M. testá ovato-oblongá, ad basin late emarginatá; spirá brevissimá: aperturá elongato-

angustá; labro sub-marginato, intús crenulato, posticè dilatato; columellá rectá, quinquies plicatá.

Shell oblong, ovate, with a very short obtuse spire, formed of but few whorls, the sutures of which are barely separated from each other; the body-whorl, which of itself forms almost the entire shell, is widely but not deeply notched in front. The mouth is long, narrow, and curved at the posterior extremity; the columella straight and, generally, furnished with five folds, occasionally with six or even more; the anterior folds are larger and more oblique than the others, which decrease in size as they ascend the columella. The outer lip is curved, expanding near the suture into a rounded wing-shaped projection; it is finely crenulated within, slightly thickened, and presents a narrow raised border running along the outer margin.

Some confusion appears to exist between the present species and a living species common in the Mediterranean (*M. miliacea*), placed by Lamarck in his genus *Volvaria*. This latter species is mentioned by Dujardin as occurring in the miocene formation in the neighbourhood of Tours; and Philippi and Sismonda have also recorded it as found in the upper miocene of Piedmont. Dujardin's shell, however, appears to be distinct, and the identification of the last is very questionable. The same species is also cited by Grateloup, although with a query, as identical with the present species, to which he has referred some shells from the miocene beds of Bourdeaux and Dax; but which, as well as certain shells from the synchronous beds of Turin, described by Michelotti as *M. ovulata*, belong to a different species to which D'Orbigny has given the name *M. sub-ovulata*. On the other hand, a *Marginella* from the miocene beds near Vienna, formerly considered to belong to the present species, has been regarded by Hörnes as identical with *M. miliacea*, and Philippi has also recorded a shell from Westeregeln, as belonging to the recent species. Dr. Beyrich, however, has pointed out with much precision, the specific differences between the *M. miliacea* and *M. ovulata*, and he seems to think that the shells mentioned by Hörnes and by Philippi, belong in fact, to the present species, which, apparently, is confined to the older tertiary formations; while, as yet, there is no ground for considering that *M. miliacea* occurs in any formation older than the upper miocene, if it occur even in that.

Whether or not the German shells are referable to the present species, is a doubtful question. The figure given by Dr. Beyrich does not agree with the French shells; the spire is more produced; the aperture, consequently, is proportionally shorter, and it is wider in front; the outer lip, apparently, is without the wing-shaped projection so characteristic of the true *M. ovulata*; and the folds on the columella are more distant and more oblique. Bronn's shell, so far as an opinion can be formed from the somewhat coarse and indistinct figure given by him, appears to agree much better.

The specimen figured is, I believe, unique, and although not in a very good state of preservation, is sufficiently so for determining the identity.

Size.—The French specimens of this species vary considerably in size, some ex-

ceeding half an inch in length; while others, in a state of maturity, barely attain half that size. The figured specimen is nearly 4-10ths of an inch long, by $\frac{1}{4}$ of an inch wide.

Localities.—Bracklesham, where it is very rare. *French*: Grignon, Parnes, Mouchy, Courtagnon, Creil, Vexin, Acy (fide D'Orb.). *Italian*: Castel-Gomberto, near Vicenza (fide Bronn), Magdeburgh (fide Phil.), Westeregeln? (fide Beyr.), Gainfahren? (fide Hörnes).

No. 84. *MARGINELLA PUSILLA*. *F. E. Edwards*. Tab. XVIII, figs. 6 *a*—*c*.

M. testá minimá, ovali; spirá exsertiusculá, apice obtuso: aperturá elongatá, mediocri, anticè profundè emarginatá; labro extús marginato, intús crenulato; columellá sub-rectá, quinquies vel sexies plicatá, plicis fere transversis, sub-æqualibus.

Shell minute, oval; spire slightly elevated, with an obtuse apex: aperture elongated, moderately wide and deeply notched in front; outer lip thickened along the outer margin, and finely crenulated within; columella nearly straight, with five or six folds, of which the anterior two are the longer and slightly oblique, and the others are almost transverse and nearly equal in size.

This pretty little *Marginella* appears to be perfectly distinct from all its congeners. It occurs rather plentifully in the Highcliff sands; but apparently disappears in the Barton sands and clay, as I have not met with any specimen from those deposits. It reappears in the fluvio-marine formation in Headon Hill, in which it is found sparingly.

Size.—Axis, not quite 2-10ths of an inch; diameter, 1-10th of an inch.

No. 85. *MARGINELLA SIMPLEX*. *F. E. Edwards*. Tab. XVIII, figs. 8 *a*—*c*.

M. testá ovato-oblongá; spirá brevissimá, pænè obtectá; aperturá elongatá, posticè angustá, antice latiori, ad basin latè emarginatá; labro extús incrassato, intus mutico; columellá quinquies vel pluries plicatá.

Shell small, ovate-oblong; spire short, depressed, almost concealed; aperture elongated, narrow behind, effuse, and widely but not deeply notched in front; outer lip thickened along the margin, smooth, uncrenulated within; columella with two distant slightly oblique folds in front, and three or more obscure, nearly transverse, folds behind.

This species so closely resembles *M. ovulata* in its general aspect, that a hasty comparison would lead to the two being regarded as identical: there are, however, several differences which entitle the present shell to specific distinction. The spire is shorter and more depressed, and the anterior folds on the columella are more distant, and not so oblique; but that which particularly distinguishes *M. simplex* is the condition of the

outer lip, which is smooth within, nearly straight, and without the posterior dilatation which characterises *M. ovulata*.

Locality.—Estuary bed at Mead-end, near Hordwell.

Size.—Axis, rather more than 3-10ths of an inch; diameter, 2-10ths of an inch.

No. 86. *MARGINELLA VITTATA*. *F. E. Edwards*. Tab. XVIII, figs. 7 *a—c*.

M. testá ovulatá; spirá brevissimá, depressá: aperturá elongatá, mediocri, antice effusá, profundè emarginatá; labro incrassato, intús obsoletè crenulato; columellá quadriplicatú, plicis anterioribus fere æqualibus.

Shell ovate-oblong, with a very short, depressed, almost hidden spire: aperture long, moderately wide, curved at the posterior extremity, effuse in front, and deeply notched at the base; outer lip thickened along the outer margin, feebly crenulated within; columella with three thickish, nearly equal folds in front, and an obscure one behind.

Although nearly resembling *M. ovularis* (Lamk.), this present species is easily distinguished from that by the general shape, which is shorter and broader, by the depressed spire, by the aperture, which is wider and without the contraction at the middle characteristic of the French species, and by the folds, which are not so numerous, and not quite so oblique. The narrower aperture, the smooth uncrenulate outer lip, the more numerous folds, and the greater size of *M. simplex*, separate that species from the present one.

One of the specimens exhibits faint traces of several transverse bands, from which circumstance the specific name is taken; these bands are of a dark brown colour.

Locality.—Headon Hill.

Size.—Axis, 3-10ths of an inch; diameter, rather more than half the length of the axis.

Family—VOLUTIDÆ.

Genus 23d. *VOLUTA*. *Linn.* 1767.

VOLUTA, *Scopoli*, 1777.

— *Bruguère*, 1792.

— *Lamarck*, 1801.

— *Montfort*, 1810.

MUSICA, *Humphreys*, 1797.

PLEJONA, *Bolten*, 1798.

FULGURARIA, *Schum.*, 1817.

SCAPHELLA—*HARPULA*—*VOLUTILITHES*, *Swainson*, 1840.

Gen. Char.—Shell sub-ovate or elongately fusiform, more or less ventricose; volu-

tions smooth, longitudinally ribbed, transversely sulcated or cancellated; spire short, apex pointed, or more or less mammellated; aperture longitudinal, large, notched at the base; outer lip thin and sharp-edged in the young state, sometimes thickened and plicated within at maturity; columellar plaits more or less numerous, oblique, the anterior plaits the largest.

The genus *Voluta*, as characterised by Linnæus, comprised the various shells in which the columellæ were plaited; and it represented, in fact, as a French author* has remarked, that group of genera which constituted Lamarck's family of *columellata*. After numerous dismemberments, the genus was defined first by Bruguière, and subsequently by Lamarck; but, even as thus restricted, a more extended knowledge of the animals has led to a still further curtailment of it by the withdrawal of the genera *Cymba* (Brod.) and *Melo* (Brod.)

The animal is of an oval form, with a large broad foot, extending beyond the shell on every side; the head is large, terminating in a short thick muzzle, and bearing short triangulated tentacles, at the outer bases of which the eyes are seated. The mantle, which is sometimes extended so as to cover the sides of the shell, is furnished with two lobes in front, between which it is produced into a short siphon, bent backwards towards the shell.

The recent *Volutes* are numerous, and many of them are of considerable size, and distinguished by the beauty of their colouring; they are, for the most part, inhabitants of equatorial seas, frequenting sandy bottoms. In the fossil state they are equally numerous; they first appear in the earlier cretaceous deposits, and nearly twenty species from the several formations of that epoch at Pondicherry, and in different parts of Europe, have been described by Professor E. Forbes and by Dr. Mantell, Matheron, D'Orbigny, and others. More than twice that number have been described by MM. Lamarck, Deshayes, J. Sowerby, Nyst, Philippi, and other authors, from the Eocene formations in Europe, and by Conrad and Lea from those of Maryland and Alabama, in the United States; while upwards of twenty species have also been described from the more recent formations.

On a comparison between the recent *Volutes* and their Eocene congeners, the prevailing characters of the two groups may be stated, in general terms, to be that, in the recent shells, the apex of the spire is broadly mammellated, the volutions are smooth or longitudinally costated, and the columellar folds thick and prominent; while, in the fossil shells, the apex is generally pointed, the volutions for the most part are transversely striated, sometimes cancellated, and the columellar folds are indistinct or comparatively feeble. These distinctions induced Mr. Swainson to separate the fossil species under the generic name *Volutilithes*, taking *Vol. spinosa* (Lam.) as the type. A cursory examination of the two groups, however, will suggest, I think, that a generic

* C. d'Orbigny's 'Dictionnaire Universel d'Histoire Naturelle.' Art., *Volute*.

separation is unnecessary. The mammellated apex, which is formed by the large development of the shell in embryo, cannot be regarded as a character of generic value; in fact, we find, among the recent Volutes, on the one hand, every degree of development between the broadly mammellated apex of *Vol. imperialis* and the pointed, almost mucronate, spire of *Vol. Harpa*; and among the fossil Volutes, on the other hand, we may trace the apex gradually enlarging from the small conical pullus of *V. luctatrix* and *V. spinosa* through *V. cithara*, *V. muricina*, &c., into the papillary pullus of *V. Wetherelli*, and thence into the mammellated apex of the Crag species, *V. Lamberti*. Similar variations may be observed in the condition of the columellar plaits. The characters in question, therefore, cannot, I think, be regarded as of generic value, however useful they may be for the division of the genus into groups.

Since the genus *Volutilithes* was proposed, the recent species *V. abyssicola* has been discovered. This Volute, which was dredged off the Cape of Good Hope at the great depth of 132 fathoms, presents a very close resemblance to some of the Eocene species, and appears to be the sole living representative of the group.

By far the greater part of the numerous eocene species which belong to this genus, are ribbed, or crowned with spines, and transversely furrowed; and the specific characters are taken chiefly from the varied conditions or the absence of these ornaments, and also from the condition of the outer lip, and the columellar folds. With regard to the specific distinctions which depend on the condition of the ribs and spines, or on the transverse sulcation, it must be borne in mind that these characters are subject to considerable modification by age; and that in almost all the species, the shells, even those which are simple and smooth at maturity, are, in their very early state, ribbed and coronated, as well as transversely sulcated. In some species, these ornaments disappear after the first three or four whorls; in others they become gradually more or less obliterated as the shells are enlarged; and the ribs in the young shells are, almost invariably, more numerous, and extend further over the whorl than in mature specimens. The character of the spines is subject to considerable modification, and the number of the columellar folds is also liable to slight variation in the same species. These characters, therefore, must be used with caution, and with a due regard to the apparent age of the specimens. The characters which appear to be the most certain are those which depend on the condition of the pullus or embryonic shell, on that of the notch at the base of the shell, and on the more or less effuse state of the inner lip. The condition of the notch, in case the notch itself is not preserved, will be found represented by the ridge at the base of the columella, called the "comb" or "crest," which is due to the reflexion of the base of the shell caused by the notch, and will be more or less prominent, according to the greater or less depth of the notch.

The following distribution of the English species into groups is made solely with a view to assist the student in the frequently perplexing task of arrangement; and it is

not proposed as possessing any value, except in so far as it may contribute towards the attainment of that end.

Section A. Pullus small, conicul.

a. Shell turbinate or pyriform; costated or coronated; inner lip effuse; columellar plaits few.

a. Transversely furrowed.

No. 87. *VOLUTA LUCTATRIX.* Solander. Tab. XVIII, fig. 3. Tab. XIX, fig. 3 *a—e*.

LIMINGTON THORNEY-RIBS, *Petiver*, 1764. *Gazophylacium*, t. 78, fig. 11.

STROMBUS LUCTATOR, *Solander*, 1766. *Brand. Foss. Hant.*, p. 30, figs. 64 and 67.

— DUBIUS — — — — — fig. 68.

VOLUTA MUSICALIS, *Webster*, 1814. *Geol. Trans.*, 1st ser., vol. ii, p. 204.

— LUCTATOR *Sowerby*, 1816. *Min. Con.*, vol. ii, p. 29, t. 115, fig. 1.

— — — — — 1823. — — — — — vol. iv, p. 134, t. 397.

V. testá elongato-turbinatá, costatá, transversim sulcatá, antice late emarginatá; apice acuto: anfractibus superne concavis, angulatis, undá serie spinarum, costas coronantium, donatis; spinis brevibus, cuspidatis: aperturá in medio effusá, antice angustatá; columellá duas plicas obliquas proeminentes gerenti; labro ad marginem crenulato, intus lævi, in juventá sæpe plicifero, incrassato.

Shell elongately top-shaped, contracted in front, longitudinally ribbed, transversely furrowed; whorls angular at the shoulder, concave between the angle and the suture, and widely, but not deeply, notched in front; ribs sharp, curved, extending over nearly two thirds of the whorls, and crowned by a single row of erect, laterally compressed spines. In young shells the ribs are numerous, and a second row of small, irregular spines runs round the sutural margin; but the ribs become more distant, and the second row of spines disappears as the shell approaches maturity. The furrows are numerous, regular, rather broad and flat, and roughened by the prominent lines of growth. Spire elevated and pointed, the embryonic shell consisting of two or three very small, roundish, whorls; aperture angular behind, effuse at the middle; columella round, nearly straight, furnished with two unequal, oblique, prominent folds towards the front, the anterior one of which is the larger, and generally with two or three smaller ones behind. The outer lip in the young shell thickened and frequently plicated within; the plaits, however, when they do occur, disappear as the shell is enlarged, and in adult specimens the inner surface of the lip is smooth; in all stages of growth the outer lip is crenulated on the margin. Not infrequently, specimens occur in which the pearly matter, deposited by the margin of the mantle, remains; it is spread over the front of the body whorl, extending backwards almost to the suture.

Lamarck has cited *Strombus luctator* (Brand., fig. 64) as identical with his *V. musicalis*;

the latter, however, is a shorter, thicker, and coarser shell, with a proportionally longer spire; the columellar folds are four, more transverse, and nearly equally prominent; the outer lip, in all stages of growth, is without plaits, and the inner lip, which is but little spread out, does not extend backwards beyond the suture. Brander's shell (fig. 65) does not belong to this species; and Lamarck, in fact, referred it to his *V. spinosa*, which is, however, a much less ventricose shell. It belongs to Mr. Sowerby's *V. spinosa*, var. β .; the latter is, as that gentleman suggested, a distinct species, and I have separated it under the name *V. Solandri*. Brander's *Strom. dubius* (fig. 68) is without doubt a young individual of the present species.

Size.—Axis, 5 inches nearly; diameter $2\frac{1}{2}$ inches nearly.

Localities.—Barton Cliff and the corresponding formation in Alum Bay (Stratum No. 29, Prestwich.) Bracklesham Bay?

No. 88. *VOLUTA NODOSA*. Sowerby. Tab. XIX, figs. 1 *a—h*.

VOLUTA NODOSA, Sow. 1818. Min. Con., vol. iv, p. 135; t. 399, fig. 2; vol. 7, p. 6; t. 613, fig. 1.

— — Defr. 1829. Dict. des Sci. nat., vol. lviii, p. 481.

— — Sow. 1850. Dixon's Geol. &c., of Suss., p. 103; t. 5, fig. 23.

— DEVEKA? Beyr. 1853. Die Conchyl. des Norddeut. tertiär., vol. 1, p. 61; t. 3, figs. 6 *a*, *b*, 7 *a*, *b*.

V. testá ovato-acutá, obscure costatá, transversim sulcatá; spirá elevatá, sub-conicá, apice acuto: anfractibus obtuse angulatis, biná serie spinarum nodiformium coronatis; aperturá angustá, in medio latiori; labro ad marginem crenulato, intus plicato; labio late expanso; columellá triplicatá.

Shell ovate, pointed, obscurely ribbed, transversely furrowed; spire elevated, almost conical, with a small pointed apex; whorls, five or six, slightly convex, obtusely angulated at the shoulders; the ribs, which in the fully-grown shell are obscure and scarcely extend to the middle of the whorl, terminate at the shoulder in a row of blunt, nodiform spines; a second row of blunt spines, corresponding with the first, runs round the sutural margin, but becomes almost obsolete on the last whorl. The space between the suture and the shoulder is moderately wide, slightly concave, obscurely sulcated; the furrows on the whorls are narrow, concave, and separated by wide flat spaces, roughened by sharp conspicuous lines of growth. The aperture is rather narrow at each extremity, wider in the middle; the outer lip bluntly angulated towards the posterior extremity, crenulated on the margin, and plicated within; the inner lip is spread over the front of the body-whorl, extending backwards to the spines on the preceding whorl, and much thickened; the columella is a little flattened, and furnished with three folds, the anterior one of which is distant from the others, and large and prominent.

The present species, founded on a specimen from Barton Cliff, is widely spread, and ranges downwards to our older Eocene formations; since the Volutes which

occur so abundantly in the neighbourhood of London, as well as some from Bracklesham Bay, although they present points of difference, yet, on the whole, agree so closely with the type that they cannot be regarded otherwise than as local varieties. In the Highgate shells (figs. 1 *c*, *d*,) the second row of spines disappears more early than in the Hampshire specimens, and the sutura margin is much thickened; the columella and the folds upon it, in the younger specimens, resemble those of the type, but, in the mature shell, the columella is more flattened, and additional folds arise among the normal ones, which latter become thicker and more prominent, the whole assuming a callus-like appearance; the outer lip also is thickened, and the principal spines are not so nodiform. The identity of the Bracklesham Bay shells (figs. 1 *e*, *h*,) with the present species is not so obvious; in them the whorls are wider and more sharply angulated on the shoulder, the ribs are generally more distant, and the spines acute and larger; but among the Highgate shells individuals occur in which the whorls are more sharply angulated, and the spines sharp and projecting. In the thickened sutural margin, the thick, plicated outer lip, the condition of the columella, and the character of the columellar folds, the Bracklesham Bay shells agree with those from Highgate, and I am unwilling, therefore, to consider them to be distinct from the present species.

Dr. Beyrich (*loc. cit.*) has described a Volute from Westeregeln, in Magdeburg, which he has named *V. devexa*, and which he considers to be identical "with a species from Barton not described by Mr. Sowerby;" and, he adds, that "most certainly" his species cannot be the young condition of "*V. nodosa*, for which the species in question from Barton seems to have been considered." Dr. Beyrich refers to the Highgate Volute, figured in vol. 7, Min. Con. (t. 613, fig. 1), which, he says, "in fact resembles the *V. devexa* of Barton;" and also to the Bracklesham Bay Volute figured in Mr. Dixon's work; and this last, he adds, "judging from the figure, is scarcely distinguishable from the Barton species." One of the prominent characters of the Hampshire shells is the very obtuse angle at which the whorl is bent at the shoulder, giving a sub-conical form to the spire. This character distinguishes the Highgate shells, although, as I have stated, it is less strongly marked in those from Bracklesham Bay; it is also found in the Westeregeln shells, and is particularly noticed by Dr. Beyrich; but I know of only one other Volute from the Hampshire beds which possesses it (*V. ambigua*, Sol.), and this species, even in the costated variety, is perfectly distinct. I am at a loss, therefore, to conceive what the Barton shell is to which Dr. Beyrich refers. His *V. devexa* agrees so closely with the Highgate form, both in description and figure, that considering, as I do, the Highgate shell to be merely a local variety of the Hampshire *V. nodosa*, I should have cited *V. devexa* as identical without hesitation, had not that gentleman expressly stated that it could not be referred to the present species.

Size.—Axis, 2 inches; diameter, 1 inch.

Localities.—Barton, Bracklesham Bay, Highgate, Sheppey. *German*, Westeregeln in Magdeburg? (fide Beyr.)

No. 89. VOLUTA AMBIGUA. *Solander*. Tab. XIX, figs. 4, *a—c*.STROMBUS AMBIGUUS, *Soland.* 1766. Brand. Foss. Hant., p. 32 ; t. 5, fig. 69.VOLUTA BICORONA, *Webster*. 1814. Geol. Tran., 1st Ser., vol. ii, p. 204.— AMBIGUA, *Sowerby*. 1823. Min. Con., vol. iv, p. 135 ; t. 399, fig. 1.Nec — — *Lamk.* 1811. Ann. du Mus., vol. xvii, p. 78, No. 12.nec — — *Ib.* 1822. Hist. natur., &c., vol. x, p. 352, No. 12.nec — — *Desh.* 1824-37. Desc. des coq. foss., vol. ii, p. 691 ; t. 93, figs. 10, 11.nec — — (Var. *Monstrosa*) *Sow.* 1816. Min. Con., vol. ii, p. 31 ; t. 115, fig. 5.nec — — *Mant.* 1822. Foss. of the S. Downs, p. 108 ; t. 18, fig. 8.nec — — *Grat.* 1845. Conchyl. foss., &c., de l'Adour, t. 1, figs. 14, 15.nec — — *Rouault.* 1850. Desc. des foss., &c., de Pau. (Mém. de la Soc. Géol. de France, 2d ser., vol. iii, p. 457 ; t. 18, figs. 15, 16.)nec — — *D'Arch.* 1850. Desc. des foss. du groupe Nummul. (Mém. de la Soc. Géol. de France, 2d ser., vol. iii, p. 447.)

V. testá ovato-oblongá, costellatá, transversim sulcatá, ad basin emarginatá ; spirá conicá, elevatá, apice acuto : anfractibus convexis, per-obtuse angulatis ; costellis numerosis, irregularibus, tuberculis per-minutis, acutis, terminantibus : aperturá postice sub-canaliculatá, angustatá, in medio effusá ; labro intus incrassato, plicato, ad marginem crenulato ; columellá sub-rectá, rotundatá, bis vel ter plicatá.

Var. COMPRESSA testá costatá ; anfractibus angulatis ; costis pro-eminentibus, sub-distantibus, compressis, tuberculis nodiformibus coronatis.

Shell ovately oblong, longitudinally ribbed, transversely furrowed, widely, not deeply notched in front ; spire conical, elevated, pointed ; whorls convex, scarcely angulated at the shoulder ; ribs numerous, irregular, slender, extending nearly to the base of the shell, and terminating above in a single row of very small spines or pointed tubercles ; in the young state a second row of imperfect spines runs round the whorl near the suture, but disappears as the shell is matured. The space between the suture and the row of tubercles is nearly flat, and presents a slender, but prominent, raised line running along the middle, and sometimes an additional faint one on each side of the centre line. The furrows are rather numerous, irregular, and traversed by very fine, but conspicuous, lines of growth. The aperture is contracted at the posterior extremity, effuse at the middle ; the outer lip much thickened, plicated within, and crenulated on the edge ; the columella round, straight, and furnished with two nearly equal prominent oblique folds in front, and sometimes one or two obscure ones behind.

The rounded shoulders, convex whorls, and conical spire, impart to this Volute a regularity of form which distinguishes it from all its congeners. The margins of the mantle of the animal appear to have been capable of considerable extension, for the porcellaneous matter deposited is occasionally found widely spread, covering the whole

of the under surface of the body-whorl, and reaching almost to the very apex of the spire.

A Volute from the lower *calcaire grossier* has been referred by Lamarck, and subsequently by Deshayes, to Brander's *Strom. ambiguus*; the French shell, however, is quite distinct, not only as to the spire, which, owing to the flattened sutural margin of the whorls, has a turreted aspect, but also as to the condition of the spines, the columella, and the columellar folds. Lamarck's shell is, in fact, the *V. elevata* of Sowerby. Deshayes has also cited Brander's fig. 70 for his *V. ambigua*; that shell is, however, equally distinct; it is the *V. suspensa* of Sowerby. Lamarck's *V. bicorona*, for which that author, as well as Deshayes, has cited Brander's fig. 69, is distinguished from this species by the double row of tooth-like spines which crowns the whorls, by the shorter and less conical spire, and by the smooth outer lip.

Specimens frequently occur in the sands of Barton, in which the ribs are less numerous, more prominent, and laterally compressed; the tubercles assume the form of erect, blunt spines: the outer lip is thin and crenulated, and, in many instances, smooth within, although in others a comparatively feeble internal plication is found. These specimens present a close resemblance to immature shells of *V. luctatrix*, and, on a cursory examination, might be referred to that species. The largest of the many I have seen, barely exceeds in size the individual figured (fig. 4, c), and, in all instances, the conical form of the spire and the obtusely angulated condition of the whorls which characterise the present species are found. I am induced, therefore, to regard these shells as forming a variety of *V. ambigua* rather than of *V. luctatrix*.

The Volute from the chalk formations of Sussex, described by Dr. Mantell, does not belong to the present species to which that author referred it, and D'Orbigny ('Prod. de Pal.,' vol. ii, p. 154, No. 171) has named it *Pseudo-ambigua*. Grateloup's shells, from Dax, Gaas, and Lesbarritz, belong to Lamarck's *V. ambigua*, to which species they are referred.

Size.—Axis, rather more than 2 inches; diameter, 9-10ths of an inch.

Localities.—Barton; Alum Bay (Stratum No. 29, Prestwich).

No. 90. *VOLUTA DIGITALINA*. Lamarck. Var. *LIMA*. Sowerby. Tab. XIX, figs. 2 a—c.

BUCCINUM SCABRICULUM, Sol. 1766. Brand. Foss. Hant., p. 33; t. 5, fig. 71.

VOLUTA DIGITALINA, Lamk. 1811. Ann. du Mus., vol. 17, p. 77, No. 10.

— — *Ib.* 1822. Hist. Nat., vol. vii, p. 351, No. 10.

— *LIMA*, J. Sow. 1823. Min. Con., vol. iv, p. 136; t. 398, fig. 2.

— *DIGITALINA*, Defr. 1829. Dict. des Sci. nat., vol. lviii, p. 477.

— — *Desh.* 1824-37. Desc. des coq. foss., vol. ii, p. 693; t. 93, figs. 1, 2.

— *LIMA*, Morris. 1843. Cat. Brit. Foss., p. 168.

— *SCABRICULA*, D'Orb. 1850. Prod. de Pal., vol. ii, p. 415, No. 1468.

— *CRENULATA*. Sow. 1850. Dixon's Geol., &c., of Sussex, t. 5, fig. 22.

V. testá ovato-oblongá, costatá, transversim sulcatá, antice sub-profunde emarginatá; spirá brevi, acuminatá: anfractibus convexiusculis, uná serie spinarum dentiformium coronatis, ad margines suturales planatis; costis numerosis, angustis, acuti-nodosis, ad basin tendentibus: aperturá elongato-angustá; labro intus incrassato, plicato, ad marginem crenulato; columellá triplicatá.

Shell oblong-oval, ribbed, transversely sulcated, rather deeply notched at the base; spire short, pointed; the ribs narrow, rather numerous, extending to the very base of the whorl: whorls rather convex, crowned by a single row of short, erect, sharp tooth-like spines, between which and the suture the margin is flattened, forming a narrow channel or ledge, which runs round the spire and gives a turreted aspect to the shell. The furrows are separated by a narrow line, which rises into small pointed knobs, where it crosses the ribs, and are roughened by numerous sharp, perspicuous lines of growth; the last furrow, immediately in front of the spines, is wider than the rest. The aperture is long and narrow; the outer lip thickened, plicated within, and crenulated on the margin; the inner lip is not much spread over the body whorl, and does not extend backwards beyond the suture.

In the French shells the ribs are close and broader; the elevated parts, where they are crossed by the furrows, are consequently blunter and more nodiform than in the English shells; the ribs also, instead of being crowned with erect pointed spines, terminate in thick round knobs, which extend partly over the margin towards the suture, and the outer lip, although thickened, appears to be not plicated within. Dr. Beyrich considers *V. lima* to be a different species to *V. digitalina*; but in all respects, except those pointed out, the two agree so well that, notwithstanding this high authority to the contrary, I regard the French shell as a local variety only of Brander's *Bucc. scabriculum*.

The shell from Bracklesham Bay, figured in Mr. Dixon's work (t. 5, fig. 22) as *V. crenulata*, belongs in fact to this species. Defrance, indeed, suggests that *V. scabriculum* may probably be only a variety of *V. crenulata*, modified by local conditions. It is difficult to ascertain to what extent specific characters may be modified by external conditions; but the different sculpture, the narrower aperture, the deeper notch, the less effuse inner lip, and the thickened plicated outer lip of the shells under description, appear to me to justify their being retained as a distinct species.

Size.—Axis, 1 inch and 4-10ths nearly; diameter, 6-10ths of an inch nearly.

Localities.—Barton, Alum Bay (Stratum No. 29, Prestwich), Highcliff, Bracklesham Bay. *French*: Valmondois, Betz, Monneville, Tancrou (fide Desh.).

No. 91. VOLUTA ELEVATA. *Sowerby*. Tab. XX., figs. 2. *a—d*.

- VOLUTA AMBIGUA, *Lamk.* 1811. Ann. du Mus., vol. xvii, p. 77, No. 12.
 — — *Id.* 1822. Hist. nat. &c., vol. vii, p. 352, No. 12.
 — — *Desh.* 1824-37. Descr. des coq. foss., vol. ii, p. 691; t. 93, figs. 10, 11.
 — ELEVATA, *Sow.* 1840. Min. Conch., vol. vii, p. 7; t. 613, fig. 4.
 — AMBIGUA, *Gratel.* 1845. Conch. foss. &c., du bassin de l'Adour, Supp. Volutes, t. i, figs. 14, 15.
 — — *D'Arch.* 1850. Desc. des foss. du groupe Numm. (Mem. de la Soc. Géol. de France, 2d ser., vol. iii, p. 447).
 — — ? *Rouault.* 1850. Desc. des foss. &c. des environs de Pau (Idem, 2d ser., vol. iii, p. 457).
 — SUB-AMBIGUA, *D'Orb.* 1850. Prod. de Paléont., vol. iii, p. 10, No. 150.

V. testá oblongo-ovatá, sub-turritá, transversim sulcatá, longitudinaliter costatá; spirá elevatá, acutá: anfractibus convexiusculis, ad margines suturales planatis; sulcis posticis latioribus; costis fere ad basin tendentibus, duas vel tres series spinarum dentiformium inter sulcos posticos gerentibus: labro ad marginem crenulato; labio parum expanso; columellá tri-plicatá.

Shell of a lengthened oval form, longitudinally ribbed, transversely furrowed, deeply notched at the base; spire elevated with a small pointed apex: whorls slightly convex, with the sutural margins depressed so as to form a narrow flat space, which runs round the spire; furrows numerous and regular until they approach the shoulder of the whorl, where the last three or four become gradually wider; the longitudinal ribs, which are more or less numerous in different individuals, extend almost to the very base of the whorl, and are surmounted by several rows of short tooth-like spines rising out of the spaces which separate the posterior furrows. The outer lip is smooth within, and crenulated on the margin by the transverse sulci; the inner lip is but slightly spread out, and does not extend backwards beyond the suture; the columella bears three very oblique folds, of which the anterior one is the largest.

This species was founded on a shell from the neighbourhood of London; it occurs also at Bracklesham Bay, but in the specimens from that locality the spire is not so elevated, and the shell is altogether shorter and broader.

The French shells referred by Lamarck to Brander's *Strombus ambiguus*, belong to the present species; but in them, as in the Bracklesham Bay shells, the spire is less elevated, and the shell is broader. In other respects they agree with the type.

A beautiful series of this Volute was obtained from the Artesian well at Southampton by Mr. Keele, for the use of which I am indebted to the kindness of that gentleman. One of this series is represented by figs. 2 *c, d*; figure 2 *b* is taken from a specimen from Highgate.

M. Rouault has described some shells from Bos d'Arros, in the neighbourhood of Pau, which he considers to be varieties of Lamarck's *V. ambigua*; but, judging from the figures given, they appear to be equally distinct from that species, and from Solander's *Stromb. ambiguus*. M. D'Archiac merely records the species without figure or description; but one of the localities given by him is Bos d'Arros, and the shells to which he refers may, therefore, belong to the same species as those described by M. Rouault. I have on this account cited his work, as well as that of M. Rouault, with a query. The shells from Dax and its neighbourhood, figured by Grateloup, D'Orbigny considers to belong to a distinct species, which he has named *V. sub-ambigua*; but, judging from the figures and from the only specimens I have seen from that locality, they appear to belong to Lamarck's *V. ambigua*, and I retain them as identical with the present species, although presenting some trifling differences.

Size.—Axis, 1 inch and 9-10ths; diameter not quite 9-10ths of an inch.

Localities.—Highgate, Camden Town, Hornsey, Nuneham, Southampton, and Bracklesham Bay. *French*: Rétheuil, Cuise-Lamotte, Dax, Gaas, Lesbarritz, (fide Grat.), Biarritz, Bos d'Arros, Les Corbières (fide D'Arch.), Valognes? (fide Rouault)?

No. 92. *VOLUTA CRENULATA*. Lamarck. Tab. XX, figs. 1. *a—b*.

VOLUTA CRENULATA. Lamk. 1802. Ann. du Mus., vol. i, p. 478, No. 8. vol. xvii, p. 77, No. 9.

—	—	<i>Ib.</i>	1816. Tableau Encyc. et Méth., t. 384, fig. 5.
—	—	<i>Ib.</i>	1822. Hist. natur., &c., vol. vii, p. 351, No. 9.
—	—	<i>Defr.</i>	1829. Dict. des Sci. nat., vol. lviii, p. 476.
—	—	<i>Desh.</i>	1833. Encycl. méthod. (Vers.) vol. iii, p. 1145, No. 28.
—	—	<i>Ib.</i>	1824-37. Descr. des coq. foss., &c., vol. ii, p. 693; t. 93, fig. 5—9.
—	—	<i>Bronn.</i>	1838. Lethæa geognost., p. 1106; t. 42, fig. 4.
—	—	? <i>Brogn.</i>	1823. Sur les terr. &c. du Vicent., p. 63.
—	—	? <i>Bronn.</i>	1831. Ital. Tertiärgeb., &c., p. 18, No. 55.
Non.	—	<i>Sow.</i>	1850. Dixon's Geol., &c., of Sussex, t. 5, fig. 22.

V. testá oblongo-ovatá, costas longitudinales creberrimas, acutas, dentato-crenatas, ad basin tendentes et sulcis transversis numerosis decussatas, gerenti, anticè parum emarginatá; spirá brevi, sub-turritá, apice acuto: anfractibus ventricosus, superne bi-canaliculatis, duplici serie spinarum dentiformium coronatis; columellá quadruplicatá.

Shell ovate-oblong, rather ventricose, transversely furrowed, longitudinally ribbed, and but slightly notched in front; spire short, with a small pointed apex: whorls convex, depressed at the sutural margin, presenting a narrow channel round the spire, crowned by a double row of short, erect, pointed spines, which correspond with the posterior extremities of the ribs; the ribs, which are crowded, narrow, and extend to the very base, are cancellated by deep, transverse furrows, and at the points of section rise into tubercles, which, near the base of the whorl, are short and nodiform, but which, as they approach

the posterior margin, become gradually elevated and sharp, until at length the tubercles between the last three or four furrows assume almost the character of the spines which crown the whorls. The transverse furrows are numerous, and the last, which separates the two rows of spines, is much wider than the others. The aperture is moderately wide; the outer lip thin and crenulated on the margin by the furrows, but smooth within; the inner lip spread widely over the body whorl, extending backwards a little beyond the aperture; the columella presents four not very oblique folds, of which the anterior one is the largest and most prominent, and the posterior two are feeble.

In the French specimens of this beautiful Volute the ribs are more numerous and stronger, and the tubercles at the points of decussation are consequently more nodiform, and are less elevated than in the English shells. A similar variance characterises the French *V. digitalina*, as I have before observed, and as our specimens of the present species agree very well in other respects with the French shells, I can only regard them as a local variety.

It is this species which the recent *V. abyssicola* most nearly resembles; but although that interesting shell presents a striking analogy with it, the much closer, more sharply defined, and more delicate character of the cancellation which ornaments the surface, the shorter spire, the more oblique and more slender columellar folds, and the less expanded inner lip sufficiently distinguish it.

Brogniart, in his list of fossil shells from the tertiary formations of the Vicentin, mentions the present species, but remarks that it approaches more nearly to the Barton form than to that from the Paris Basin; an observation which is repeated by DeFrance. As *V. digitalina* is the Barton Volute which presents the nearest affinity to *V. crenulata*, it is to that species I presume that these authors refer; it is doubtful, therefore, whether the Vicentin shells ought not to be referred to *V. digitalina* rather than to the present species, and as I have not had an opportunity of examining any specimens, I have cited the Italian Volutes, but with doubt. The shell represented by fig. 22 (t. 25) in Mr. Dixon's work, and referred by Mr. Sowerby to this species, appears to me, as I have already observed, to belong to *V. digitalina*.

Size.—

Localities.—Bracklesham Bay. *French*: Parnes, Grignon, (fide Desh.). *Italian*: Ronca, Val Salgonini, (fide Bronn et Brogn.)?

No. 93. *VOLUTA SOLANDRI.* *F. E. Edwards.* Tab. XX, figs. 6. *a—d.*

STROMBUS LUCTATOR, *Soland.* 1766. Brand. Foss. Hant., p. 30; t. 5, fig. 65.

VOLUTA SPINOSA, *Webster.* 1814. Geol. Trans., 1st ser., vol. ii, p. 204.

— — *Sow.* 1816. Min. Con., vol. ii, p. 30, t. 115, fig. 2—4.

— — *Morris.* 1843. Cat. Brit. Foss., p. 168.

V. testá ovato-oblongá, longitudinaliter costatá, transversim sulcatá; spirá mediocri,

apice acuto : anfractibus ventricosis, biná serie spinarum armatis ; spatio inter series concavo : aperturá ovato-elongatá, in medio effusá, anticè parum coarctatá ; labro tenui, simplici ; labio expanso, posticè incrassato ; columellá leviter arcuatá, bis vel ter plicatá.

Shell oblong, ventricose, longitudinally ribbed, transversely furrowed; spire moderately elevated, with a small pointed apex; the ribs, which are more or less numerous in different specimens, extend over nearly the whole length of the whorls, and terminate posteriorly in a row of erect, sharp spines. Close to the edges of the whorls rises a second row of smaller spines, the space between it and the suture forming a channel round the spire more or less deep, according to the height of the spines. The two rows of spines are connected by raised lines, and the intermediate space is concave. On the last whorl or two of the fully formed shell, the second row of spines frequently becomes obsolete, and is replaced by a sharp, elevated ridge. The furrows, in young specimens, extend over the whole surface of the whorl, but, as the shell advances towards maturity, the posterior ones become faint, and at length are frequently almost obliterated. The mouth is contracted in front, effuse near the middle, and deeply notched at the base. The outer lip is in all stages of growth thin, sharp-edged, and quite smooth within; the columellar lip is moderately spread out over the body whorls, and thickened behind, and does not extend backwards beyond the suture. The columella, which is slightly arched, presents in the young state, two unequal, not very oblique plaits, in front of which a third obscure plait generally appears at maturity.

Brander's shell (fig. 65), referred by Solander to *V. luctatrix*, and by Lamarck to *V. spinosa*, presents nevertheless characters sufficiently distinct to entitle it, as Mr. Sowerby long ago suggested, to be considered as belonging to a separate species. In addition to the distinction afforded by the rows of spines, which are more equal and more permanent in this species than usual, it will be seen, on comparison with *V. luctatrix*, that in *V. Solandri* the shell is shorter and broader, the spire not so much elevated, the outer lip always sharp edged, and without plication, the inner lip not so effuse, the columella arched, and the columellar folds neither so numerous nor so large; and, on a comparison with *V. spinosa*, that the shell is not so turbanate, the spire more elevated, and the whorls more ventricose.

Size.—Axis, 2 inches nearly; diameter, rather more than 1 inch.

Locality.—Barton.

No. 94. *VOLUTA SCALARIS*. Sowerby. Tab. XX, figs. 5 *a—c*.

VOLUTA SCALARIS, Sow. 1843: Min. Con., vol. vii, p. 32; t. 625, fig. 4—5.

V. testá ovatá, ventricosá, anticè attenuatá ; spirá elevatá, apice acuminato : anfractibus costatis, biná serie spinarum coronatis, transversim sulcatis, ad margines suturales depressis, inter series spinarum concavis ; costis numerosis ; sulcis sub-distantibus, æqualibus : labro simplici, acuto ; labio parum expanso ; columellá sub-rectá, triplicatá.

Shell ovate, very ventricose, much attenuated and deeply notched in front; spire elevated; apex pointed. The whorls, six or seven, longitudinally ribbed, transversely furrowed; ribs numerous and sharp in young specimens, more distant and rounded in mature shells, and crowned with a double row of erect, sharp, nearly equal spines; the furrows, which are rather distant and regular, extend up to the front row of spines, but in fully formed shells often become obliterated over the posterior part of the last whorl. A narrow flat border runs round the whorls between the suture and the second row of spines, and the space between the two rows is concave. The outer lip is thin, sharp, and quite smooth within; the inner lip is not much spread out, and does not extend backwards beyond the suture; the columella, which is slightly curved, presents three folds.

This shell so closely resembles *V. Solandri* that it may, perhaps with greater propriety, be regarded as a dwarf variety of that species, rather than as being distinct from it. It is, however, more ventricose, with a longer spire and more nearly equal spines; the inner lip is less spread over the ventral surface of the body whorl, and the notch is not so deep.

The species occurs in abundance at Highcliff, but in the specimens from that locality the spines are blunt, almost nodiform, and the furrows more numerous. The same variety occurs at Alum Bay, and occasionally, though rarely, at Barton.

Size.—Axis, 1 and 2-10ths of an inch nearly; diameter, 7-10ths of an inch.

Localities.—Barton, Highcliff, Alum Bay (Strat. No. 29, Prestwich).

No. 95. *VOLUTA RECTICOSTA*. Sowerby. Tab. XX, fig. 3.

VOLUTA RECTICOSTA. Sow. 1850. Dixon's Geol., &c., of Suss., p. 188; t. 5, fig. 18.

V. testá ovato-oblongá, costatá, transversim sulcatá, anticè subrostratá, parum emarginatá; spirá mediocri apice acuto: anfractibus ventricosus, duplici serie spinarum coronatis; spatio inter series spinarum concavo; costis numerosis, rectis, tenuibus, primam seriem spinarum gerentibus; labro tenui.

Shell oval-oblong, ribbed, transversely furrowed; spire moderately elevated, terminating in a small pointed apex; whorls ventricose, contracted rather suddenly in front, so as to give a beak-like form to the base, crowned with two not very distant rows of short, erect, sharp spines; ribs numerous, thin, straight, scarcely extending beyond the middle of the whorl, and each terminating in a spine; the margins of the whorls between the two rows of spines concave. The outer lip thin, sharp edged, and smooth within. The basal furrows are strongly marked, and extend higher up the whorl than is usually the case. The notch in front is not deep.

The figure is taken from the original specimen described and figured by Mr. Sowerby; this specimen, which forms part of Mr. Dixon's collection, is unfortunately somewhat crushed and distorted. No traces of the inner lip remain, and the aperture

is filled with the matrix, so that the columellar folds cannot be seen. Mr. Sowerby, in his description, expressed an opinion that this shell might probably be the same as *V. ambigua* (Lamk.); the two rows of spines and the hollow space between them, however, appear to distinguish it. I am more inclined to refer it to *V. scalaris*, or to regard it as a young shell of *V. solandri*; but the short spire, numerous straight ribs, and the deep basal furrows distinguish it apparently from the former; while these characters, as well as the general form of the shell, which is more ventricose and more contracted in front than in *V. solandri*, appear to separate it from the latter species. A young specimen from Stubbington, in M. D'Urban's collection, presents the same characters as the one figured; and additional specimens may establish the species; in the meantime I retain it, but with some doubt.

Size.—Axis, 1 inch and 2-10ths; diameter, 6-10ths of an inch.

Localities.—Bracklesham Bay, Stubbington.

No. 96. *VOLUTA SUSPENS*A. *Solander*. Tab. XX, figs. 4 *a*—*c*.

MUREX SUSPENSUS. *Soland*. 1766. Brand. foss. Hanton., p. 32; t. 5, fig 70.

VOLUTA CRENULATA. *Webster*. 1814. Geol. Trans., 1st series, vol. ii, p. 204.

— *AMBIGUA*, VAR. *MONSTROSA*. *Sow*. 1816. Min. Con., vol. ii, p. 31; t. 115, fig. 5.

— *SUSPENS*A. *Sow*. 1823. Min. Con., vol. iv, p. 137.

V. testá ovato-oblongá, sub-turritá, costatá, transversim sulcatá, ad basin sub-productá, parum emarginatá; spirá elevatá, acuminatá, canali lato, marginibus anfractuum repente inflexis septo, circumdatá: anfractibus sub-ventricosis, dentato-crenatis; costis obscuris, distantibus, uná serie spinarum coronatis: aperturá postice acute angulatá, antice coarctatá; labro simplici tenui; columella biplicatá.

Shell oval-oblong, turreted, ribbed, transversely furrowed; spire elevated, pointed; whorls somewhat ventricose, the posterior margins suddenly bent inwards, forming round the spire a broad deep canal, bounded by a sharp denticulated ridge. The ribs, numerous in the young shells, but becoming more distant towards maturity, extend nearly to the base of the whorl, and terminate posteriorly in sharp, tooth-like spines. At the posterior extremities of the ribs, the whorl is depressed, and presents a narrow flat space, which forms, as it were, a platform from which the sharp ridge bounding the spiral canal rises. The furrows at the base are broad and rounded; the others distant and angular. The aperture is contracted, and produced in front, wide in the middle, sharply angulated behind; the outer lip thin and smooth within: the columella nearly straight, presenting two very unequal folds.

This is the rarest of the Barton Volutes; it may be readily distinguished by the broad deep channel which runs round the spire.

Size.—Axis, 3 inches; diameter, 1 inch and 6-10ths.

No. 97. *VOLUTA TRICORONA*. Sowerby. Tab. XX, figs. 7 *a—d*.*VOLUTA TRICORONA*. Sow. 1843. Min. Con., vol. vii, p. 6; t. 613, fig. 2.

V. testá ovato-rhomboidali, costatá, transversim sulcatá, antice profunde emarginatá; spirá brevi, apice acuto; anfractibus obtuseangulatis, triplici serie spinarum nodiformium coronatis; costis numerosis, angustis, fere ad basin tendentibus; sulcis transversis irregularibus, lineis incrementi decussatis: aperturá elongato-ováli, postice subcanaliculatá; labro simplici, lævi; labio effuso; columellá buplicatá.

Shell rhomboidal-ovate, longitudinally ribbed, transversely furrowed; spire short, apex small, pointed: whorls bluntly angulated at the shoulder; ribs rather numerous, narrow, extending almost to the base, and surmounted by three rows of short nodiform spines; furrows rounded, shallow, crowded and irregular on the posterior part of the whorl, deep, distant, and regular towards the base; decussated by thick conspicuous lines of growth: aperture of a lengthened ovate shape, deeply notched in front, and terminating behind in a short, wide canal; outer lip thin, smooth within; columella nearly straight, flattened on the anterior surface, and furnished with two folds, of which the front one is thick and very oblique. Only imperfect traces of the inner lip remain in the specimens I have seen, but it was apparently widely spread, covering the front of the body whorl, and stretching backwards far up the spire.

This Volute, which appears to be peculiar to the lower formations, is very rare. In the general form it resembles *V. denudata* so much that a worn individual might easily be mistaken for one of that species. The *V. denudata* is, however, distinguished by its single row of thick nodiform tubercles, the rounded dome-like shape of the posterior margin, and the smooth upper surface of the body-whorls. Fig. 7 *d* is taken from the original specimen figured in 'Mineral Conchology.' This, and also the specimens represented by figs. 7 *a, e*, form part of Mr. Wetherell's collection.

Size.—The largest specimen I have seen has lost the upper part of the spire, but when perfect, the dimensions would have been, axis, 2 inches, nearly; diameter 1 and 1-10th of an inch.

Localities.—Primrose Hill, Copenhagen Fields, Potter's Bar.

No. 98. *VOLUTA PUGIL*. F. E. Edwards. Tab. XXII, figs. 1 *a—c*.*VOLUTA SPINOSA*. Sow. 1850. Dixon's Geol., &c., of Suss., p. 107; t. 5, fig. 16.— — var. *PLATYSPINA*. Sow. 1850. Dixon's Geol., &c., of Suss., p. 107; t. 7, fig. 29.

V. testá ovato-oblongá, antice attenuatá, obscure costatá, transversim sulcatá; spirá brevi, apice acuto: anfractibus convexiusculis, unicá serie spinarum coronatis; spinis magnis, dis-

pansis; sulcis transversis distantibus, ad basin latis, profundis: aperturá postice sub-canaliculatá, antice late emarginatá; labro tenui, simplici; labio effuso, postice incrassato; columellá arcuatá, quater vel quinquies plicatá.

Var? PLATYSPINA, fig. 1 c. Testá tuberculis nodiformibus, crassis, lateraliter compressis, coronatá.

Shell ovately oblong, contracted at the base, obscurely ribbed, transversely furrowed, with a short, rather conical, and pointed spire: whorls angulated at the shoulder, and crowned with a single row of large, wide-spreading spines. The bases of the spines are prolonged into thick, obscure ribs, which do not extend beyond the middle of the whorls. In the young state, the ribs are numerous, and surmounted by two rows of small, sharp spines; as the shell increases in size, the ribs become more distant, and the row of spines nearest to the suture disappears, and is replaced by a sharp, elevated ridge. The transverse furrows are distant, and broad and deep at the base. The aperture is contracted in front, obscurely channelled close to the suture, and widely, but not deeply, notched in front; outer lip thin, sharp edged, and smooth within; inner lip widely spread, thickened posteriorly, and extending backwards as far as the suture; columella flattened in front, curved, and furnished with four or five folds, of which the one in front is the largest. In the last whorls, the sutural margin is spread over the preceding whorl up to the spines, which, in some instances, are covered by it.

In the specimen represented by fig. 16, tab. 5, in Mr. Dixon's work, the outer lip is broken off, and the shell consequently presents the turbate form which characterises *V. spinosa* (Lamk.); and this circumstance probably induced Mr. Sowerby to refer it to that species; from which, however, it is distinguished by the transverse furrows, and the arched and flattened columella.

In the specimen (fig. 1 c) for which the variety *platyspina* was proposed by Mr. Sowerby, the spines on the last whorl are converted into large, thick, laterally-compressed, knob-like tubercles. The animal had, apparently, attained great age; and, as I am not aware of any similar specimen having been found, I am inclined to regard the individual in question as a monstrosity rather than as a variety.

The present shells much resemble *V. athleta* in the character of the spines, and in the conditions of the inner lip and the columellar folds; but the deep transverse furrows, which continue to be strongly marked even in adult specimens, entitle them, apparently, to specific distinction.

Size.—Axis, ; diameter,

Locality.—Bracklesham Bay.

Section A. (*Pullus small, conical.*

a. *Shell turbinate or pyriform; costated or coronated; inner lip effuse; columellar plaits few.* } continued.

β. *Transversely furrowed at the base only.*

No. 99. VOLUTA ATHLETA. *Solander. Tab. XXI, figs. 7 a—e.*

STROMBUS ATHLETA.	<i>Soland.</i>	1766.	Brand. Foss. Hanton.,	p. 31; t. 5, fig. 66.
VOLUTA	—	<i>Sow.</i>	1823. Min. Con., vol. iv,	p. 133; t. 396, figs. 1—3.
—	—	<i>Defr.</i>	1829. Dict. des Sci. nat.,	vol. lviii, p. 480.
—	—	<i>Desh.</i>	1824-37. Desc. des coq. foss.,	vol. ii, p. 689; t. 93, figs. 12—13.

V. testá rhomboidali, spinis magnis dispansis coronatá, ad basin sub-profunde emarginatá; spirá brevi, acuminatá: anfractibus postice lævibus, ad basin obsolete transversim sulcatis: aperturá effusá; labro tenui, simplici; labio parum effuso, postice incrassato; columellá depressá, leviter arcuatá, tri-plicata.

Var. FORTIS (tab. 21, fig. 7 e) testá ovato-turbinatá, breviori, latiori; anfractibus antice valde attenuatis.

Shell rhomboidal, crowned with large spreading spines, and widely, but not deeply, notched at the base; spire rather short and pointed. In young individuals, the whorls are transversely furrowed, obscurely ribbed, and surmounted by two rows of short, erect spines; but as the shell approaches maturity, the ribs become effaced, the second, or sutural row of spines disappears, and is replaced by an irregular sharp elevated line, and the spines of the first row become large, distant, and spreading; the transverse furrows disappear after the first three or four whorls, and the shell is afterwards smooth, except at the base, where a few faint, almost obsolete, transverse furrows appear. The aperture is elongate, and rather wide; the outer lip smooth and simple; the inner lip moderately spread over the body whorl, thickened at the upper part, and not extending backwards beyond the suture; columella flattened in front, slightly curved, and presenting one broad prominent fold in front, and two or three others, small and indistinct, behind.

A variety occurs at Highcliff, which appears to correspond with the shell described by M. Deshayes, more closely than do the Barton shells; it is more turbinate, shorter, and comparatively wider than the type, and the whorls are much attenuated in front.

The smooth and ventricose body and flattened columella distinguish this species; and at maturity, the large spreading spines give a strongly marked character to it.

Size.—Axis, 3 inches, nearly; diameter, 1 inch and 7-10ths, nearly.

Localities.—Barton, Alum Bay (No. 29, Prestwich). For the variety, Highcliff. *French*: Monneville, Houdan (fide Desh.).

No. 100. *VOLUTA DENUDATA*. *Sowerby*. Tab. XXI, figs. 5 *a—c*.*VOLUTA DENUDATA*. *Sow.* 1840. *Min. Con.*, vol. 7, p. 6; t. 93, fig. 3.— — — 1850. *Dixon's Geol. Suss.*, p. 120; t. 15, fig. 7.

V. testá ovato-oblongá, postice lævi, antice transversim sulcatá, profunde emarginatá; spirá conicá, brevi, apice acuto; costis brevibus, crassis, ad extremitates posteriores nodigeris; anfractu ultimo superne concamerato: aperturá elongato-ovali, postice angustá; labro simplici, intús lævi; labio expanso, incrassato; columellá tri-plicatá.

Shell oblong-ovate, ribbed, smooth, except towards the base, where it is transversely furrowed; spire short, conical; apex small, pointed; ribs thick, short, scarcely extending to the middle of the whorl, and terminating posteriorly in coarse, nodiform tubercles; whorls rather ventricose in front, obtusely angulated at the shoulders; the space between the tubercles and the suture convex, imparting a dome-like shape to the lower part of the spire. The aperture is of a lengthened oval form, narrow, obscurely channelled behind, widely and deeply notched in front; the outer lip simple, smooth within; inner lip much spread over the front of the body whorl, extending backwards far up the spire, and thickened. The columella is flattened in front, and presents one thick, prominent fold in front, and two or three smaller ones behind. In the young shell, the whorls are crowned with three rows of small, nodiform spines, and the margins between the front row and the suture are somewhat depressed. The two posterior rows, which correspond with the front row, rise out of faint, elevated lines, which traverse the sutural margin; as the shell is enlarged, these spines are lost, and the transverse lines become stronger; the direction of the suture also becomes less decurrent, so that each succeeding whorl envelops more of the preceding one, and the margin of the last, in fact, covers the front row of spines upon the whorl next to it; the margins also become convex, and assume the dome-like shape characteristic of the later whorls.

Size.—Axis, 3 inches, nearly; diameter, 1 and 7-10ths of an inch, nearly.

Localities.—Bognor, where it is very common, and (*vide Sow.*) Brentford.

No. 101. *VOLUTA SPINOSA*. *Linnaeus*. Tab. XXI, figs. 4 *a, b*.

Lister. *Hist. Conchyl.*, t. 1033, fig. 7?

Gualtieri. 1742. *Index Test. Conch.*, t. 55, fig. E?

CONUS SPINOSUS. *Linn.* 1758. *Syst. Nat.*, 10th edit., p. 715, No. 271.

BUCCINUM (sp.) *Walch.* 1764. *Das Steinreich System.*, &c., t. 11, fig. 2 *a*.

STROMBUS SPINOSUS. *Linn.* 1767. *Syst. Nat.*, 12th edit., p. 1212.

— — *Favanne*. 1780. *D'Argen. Conchyl.*, 3d edit., t. 66, fig. I, 9.

— — *Schröter*. 1783. *Einleit. in die Conch.*, vol. 1, p. 443, No. 24.

— — *Gmel.* 1788. *Linn. Syst. Nat.*, 13th edit., p. 3518, No. 27.

STROMBUS SPINOSUS. *Chemn.* 1795. *Conchyl. cab.*, vol. xi, t. 212, figs. 3002—3.

VOLUTA SPINOSA. *Lam.* 1802. *Ann. du Mus.*, vol. i, p. 477, No. 2, and vol. xvii, p. 74, No. 2.

— — *Roissy.* 1804. *Buff. Moll.*, vol. v, p. 440, No. 7.

— — *Lam.* 1816. *Tableau Encyclop. et Méth.*, t. 392, fig. 5 *a—b*.

— — — 1822. *Hist. Nat.*, vol. vii, p. 348, No. 2.

— — *De France.* 1829. *Dict. des Sci. Nat.*, vol. lviii, p. 474.

— — *Desh.* 1832. *Encycl. Méthod. (Vers)*, vol. iii, p. 1143, No. 22.

— — — 1824—37. *Desc. des Coq. Foss.*, vol. ii, p. 690; t. 92, figs. 7—8.

— — ? *Galeotti.* 1837. *Mém. sur la Const. Géog., &c., de Brabant*, p. 149, No. 71, t. iii, fig. 16.

— — ? *Nyst.* 1843. *Coq., &c., de Belg.*, p. 589.

— — *Morris.* 1843. *Cat. Brit. Foss.*, p. 168.

— — ? *Philippi.* 1851. *Palæontogr. Tert. Foss. Magdeb.*, p. 78, No. 169.

Nec. — — *Sow.* 1816. *Min. Con.*, vol. ii, p. 30; t. 115, figs. 2—4.

nec. — — — 1850. *Dixon's Geol., &c., of Suss.*, p. 107; t. 5, fig. 16.

nec. — — var. *PLATYSPINA.* *Sow.* 1850. *Dixon's Geol., &c., of Suss.*, p. 107; t. 5, fig. 29.

V. testá turbinatá, ad basin transversim striatá, longitudinaliter partim costatá; anfractibus acute angulatis, unicá serie spinarum coronatis; spirá brevi, apice acuto; labro tenui, simplici; columellá quadri-plicatá.

Shell turbate, resembling in shape two unequal cones placed base to base, the smaller of which is formed by the short pointed spire; whorls nearly straight, longitudinally ribbed, much narrowed in front, and acutely angulated at the shoulder; the margin between the spines and the suture rather concave. The ribs, which extend only about half-way over the whorl, terminate at the shoulder in a row of short, pointed spines. The sutural margin is bordered by an elevated line, which, occasionally, in young shells, rises into small, pointed tubercles opposite to the spines. The whorls at the base are traversed by several oblique furrows, which disappear towards the middle of the shell, where the ribs take their rise. The mouth is narrow, and somewhat quadrilateral, owing to the angularity of the upper part of the whorl; the outer lip thin and smooth within; inner lip but little spread out. The columella, which is rather flattened in front and nearly straight, presents one large prominent plait in front, and three, sometimes four, feeble ones behind and, according to M. Deshayes, a large smooth callus at the posterior extremity formed by the thickening of the inner lip.

The shells from Barton, described by Mr. Sowerby (*loc. cit.*), and referred by him to this species, present characters sufficiently distinct, as I have before observed, to require that they should be separated. I have not met, in fact, with any shell from the Hampshire beds corresponding with the true *V. spinosa* of the Paris basin, unless the *V. depauperata* be regarded as a local variety; but the species occurs not unfrequently at Bracklesham Bay.

The French specimens are generally ornamented with numerous pale orange-coloured bands; but the English matrix has been less favorable for the preservation of the colouring matter, and specimens retaining traces of the original marking are very rare.

The shells described in Mr. Dixon's work as *V. spinosa*, and *V. spinosa*, var. *platyspina*, (p. 107, t. 7, f. 22,) do not belong to this species; nor, apparently, do those described by Galeotti from St. Josse-ten-Noode, St. Gilles, Forêt, and Affligem in Brabant; in them, the ribs are thick, round, and prominent; and the whole surface presents a transverse sculpture. Philippi records a specimen of the present species from Westeregeln, in the Museum at Halle; but as Dr. Beyrich does not mention the species among the Volutes described by him from that locality, I have cited Philippi with a query.

Size.—Axis, 1 inch and 3-10ths; diameter, nearly 8-10ths of an inch.

Localities.—Bracklesham Bay; Southampton. *French*: Grignon, Courtagnon, Parnes. *German*: Westeregeln in Magdeburg (fide Phil.)?

No. 102. *VOLUTA DEPAUPERATA*. *Sowerby*. Tab. XXI, figs. 8 *a*—*c*.

VOLUTA DEPAUPERATA, *Sowerby*. 1823. Min. Con., vol. iv, p. 133, t. 396, fig. 4; vol. vii, p. 32, t. 625, fig. 6.

— — *Defr.* 1829. Dict. des Sci. nat., vol. lviii, p. 481.

non — — *Desh.* 1824-37. Desc. des coq. foss., &c., vol. ii, p. 684, t. 92, figs. 5, 6.

V. testá ovato-oblongá, partim costatá, antice transversim sulcatá, postice levi; spirá brevi, apice acuto; anfractibus sub-ventricosis, postice acute angulatis, uná serie spinarum donatis, margine suturali sub-convexo: labro simplici, tenui; labio parum expanso; columellá biplicatá.

Shell oval-oblong, longitudinally ribbed, transversely furrowed in front, otherwise smooth, with a short pointed spire: whorls rather ventricose, acutely angulated at the shoulder. The ribs, which are not numerous, extend over about two thirds of the whorl, and terminate at the shoulder in a row of short erect spines. In young shells a second row of small pointed tubercles, corresponding with the spines, runs round the suture; but they soon disappear, and generally are replaced by an irregular raised line. The margin of the whorls, between the shoulder and the suture is slightly convex. The aperture is of a lengthened-oval shape, rather effuse and widely but not very deeply notched in front; the outer lip thin and smooth; the inner lip but slightly spread out; the columella rounded, nearly straight, and furnished with two unequal folds. The surface of the shell is ornamented with transverse, narrow, orange-coloured bands, resembling those

in the French specimens of *V. spinosa*, with which species the present one is closely analogous, and of which it appears to me to be merely a local variety. It is in fact, only distinguished by the more ventricose whorls, the more effuse aperture, the rounded columella, and the greater obliquity of the columellar folds.

Brander's shell (fig. 67), referred by Mr. Sowerby to this species, belongs to *V. luctatrix*; and the French shells which M. Deshayes has described as *V. depauperata* also appear to be quite distinct; they are longer, narrower, and more regular in form, and have a more elevated and thicker spire; and the surface of the whorl is obscurely striated.

Size.—Axis, 1 inch and 9-10ths; diameter, not quite 1 inch.

Localities.—Barton (fig. 8 *a*), and the fluvio-marine formation at Hordwell, and at Colwell Bay (figs. 8 *b*, *c*), in which latter place it occurs in abundance.

No. 103. *VOLUTA GEMINATA*. Sowerby. Tab. XXI, figs. 3 *a*, *b*.

VOLUTA GEMINATA, Sow. 1823. Min. Con., vol. iv. p. 136; t. 398, fig. 1.

V. testá ovatá, ventricosá, antice coarctatá, costatá, sub-turritá; spirá mediocriter elevatá, apice acuto; anfractibus postice levibus, ad basin transversim sulcatis, ad margines suturales depressis; costis pro-eminentibus, sub-crassis, postice biná serie spinarum nodiformium coronatis; aperturá oblongo-ovali, antice angustiori; labro tenero, simplici; labro late expanso, postice incrassato; columellá arcuatá, tri-plicatá.

Shell ovate, ventricose, contracted towards the base, ribbed; spire moderately elevated, apex very small, pointed; whorls five or six, smooth on the middle and at the posterior extremities, transversely furrowed toward the base, and flattened at the sutural margin; ribs prominent, rather thick, rounded, extending to the transverse furrows, and surmounted by two rows of short, erect, connected, nodiform spines, with a rounded, depression between them; the flattened margins of the whorls form a shallow obscure channel round the spire, imparting to it a turret-like aspect. The aperture is of a lengthened-oval shape, narrowing toward the base; the outer lip thin, sharp, and smooth within; the columellar lip much spread out over the body-whorl, but not extending backwards beyond the suture; the columella much curved, and furnished with three oblique folds.

The present species appears to be confined to the neighbourhood of Lyndhurst, where it was first discovered many years ago by Sir Charles Lyell.

Size.—Axis, rather more than 1 inch and 3-10ths; diameter, 7-10ths of an inch, nearly.

No. 104. VOLUTA HORRIDA. *F. E. Edwards.* Tab. XXI, figs. 2 *a—c.*

V. testá oblongo-ovatá, costatá, postice lævi, antice transversim sulcatá; anfractibus duplici serie spinarum dentiformium donatis; costis numerosis, lateraliter compressis, fere ad basin tendentibus, postice tuberculatis et in mucrones primam seriem spinarum formantes, prolongatis; sulcis transversis latis, profundis, costas fortiter decussantibus; spatio inter series spinarum concavo; labro tenui, simplici; columellá uniplicatá.

Shell ovate-oblong, armed with two rows of short, upright, pointed spines, ribbed, smooth behind, transversely furrowed in front; ribs numerous, thick, angular, compressed sideways toward the aperture and terminating posteriorly in sharp conical points forming the front row of spines. The ends of the ribs, immediately in front of the spines present a rounded depression at the anterior margin of which they rise into small tubercles. The transverse furrows are wide and deep, strongly decussating the ribs. The posterior margins of the whorls, between the rows of spines, are sunken and concave; the outer lip is thin, sharp-edged, smooth within?; the columella presents a single very oblique fold.

The sharp erect conical spines and the prominent ribs, deeply cut by the transverse furrows are characters so distinct, that I am unwilling not to record the species, although the only specimen I possess has lost the spire and is otherwise imperfect. It appears to be a young shell, and the actual character of the outer lip cannot be stated with certainty; there are not any traces of the columellar lip preserved.

Size.—Axis, (without the spire) $\frac{1}{2}$ inch, nearly; diameter, rather less than 3-10ths of an inch.

Locality.—Bracklesham Bay; very rare.

No. 105. VOLUTA FORBESII. *F. E. Edwards.* Tab. XXI, figs. 1 *a—d.*

V. testá turbinatá, costatá, postice lævi, antice transversim sulcatá; spirá elevatá, apice acuto; costis sub-distantibus, vix ad sulcos tendentibus, postice in tuberculos lateraliter compressos elevatis, deinde biná serie brevium spinarum coronatis; aperturá elongato-ovali, angustá, postice sub-canaliculatá, antice late emarginatá; labro intús incrassato, ad marginem acuto; labio effuso; columellá rectá, biplicatá.

Shell turbinate, ribbed, transversely furrowed at the base, smooth behind; spire elevated, pointed, with a small conical apex; ribs rather distant, extending scarcely beyond the middle of the whorls, rising at the posterior extremities into large, prominent, laterally compressed tubercles, and crowned with a single row of short, erect, tooth-like spines. The sutural margin is depressed and bordered by a raised line, which occasionally rises into minute pointed tubercles; aperture of a lengthened oval form,

narrow, obscurely channelled behind, and widely notched in front; the outer lip thickened within, thin and sharp at the edge; inner lip moderately spread over the body-whorl, and presenting at the suture a callus-like thickening, which forms the left side of the posterior canal; the columella nearly straight, and furnished with two or three not very oblique folds, the front one of which is the most prominent.

The present species approaches closely to *V. geminata*, but is much more turbinate, resembling in general form *V. spinosa*; and the anterior tubercles are different in their character; in the present species they are simply an enlargement of the ribs themselves, while in *V. geminata*, a transverse line runs round the shoulder, and rises into tubercles where it crosses the ribs; the aperture in *V. Forbesii* is also narrow and more regularly ovate. This species is found in Hempstead Cliff; and I have dedicated it to the late much lamented Prof. E. Forbes, by whose researches the position of that formation in the tertiary series, so long misunderstood, has been ascertained.

Size.—Axis, 7-10ths of an inch; diameter, 4-10ths of an inch.

No. 106. *VOLUTA CALVA*. Sowerby. Tab. XXI, figs. 6 *a*, *b*.

VOLUTA CALVA. Sow. 1850. Dixon's Geol., &c., of Suss., p. 187; t. 7, fig. 28.

V. testá pyriformi, antice transversim obsolete sulcatá, cæterum lævi, ad basin vix emarginatá; spirá brevi, conicá, apice acuto: anfractibus angulatis, unicá sine spinarum donatis, superne concavis, marginibus anfractu precedenti adpressis: aperturá elongato-ovali; labro tenui, simplici; labio parum effuso; columellá subrectá, bis vel ter plicatá.

Shell pyriform, obscurely ribbed, slightly notched at the base, and presenting several faint, almost obsolete, transverse furrows in front, smooth elsewhere; spire short, conical, with a small pointed apex: whorls angulated at the shoulder, and crowned with a single row of short, pointed tubercles; the margins pressed against the spire; the space between the suture and the row of tubercles concave. The aperture of a lengthened oval shape; outer lip thin, sharp-edged, smooth within; inner lip very thin and but little spread out; and the columella furnished with two nearly equal folds in front, and a third very feeble one behind.

The specimens are generally simply coronated; but, in some instances, the elevated bases of the tubercles are prolonged into very short, faint ribs. The angulated shoulder and the tubercles distinguish this species from the young shell of *V. Selseiensis*, with which only it might be confounded.

Size.—Axis, $1\frac{1}{2}$ inch, nearly; diameter, 7-10ths of an inch.

Locality.—Bracklesham Bay, where it is somewhat rare.

No. 107. *VOLUTA SELSEIENSIS*. *F. E. Edwards*. Tab. XXII, figs. 3 *a—f*.

VOLUTA LABRELLA. *Sow.* 1840. *Min. Con.*, vol. vii, p. 8; t. 614, fig. 2.

— — *Morris*. 1843. *Cat. Brit. Foss.*, p. 167.

— — *Sow.* 1850. *Dixon's Geol., &c., of Suss.*, p. 187; t. 5, figs. 12—14.

BULBULA. — — — — — p. 186; t. 7, fig. 35.

nec. — *LABRELLA*. *Lamk.* 1802. *Ann. du Mus.*, vol. i, p. 479, No. 10, vol. xvii, p. 74, No. 14.

nec. — *BULBULA*. *Lamk.* 1802. *Ann. du Mus.*, vol. i, p. 479, No. 11.

V. testá ovato-turbinatá, ventricosá, antice transversim sulcatá, cæterum lævi; spirá brevi, conicá, apice acuto: anfractibus prioribus costas et sulcos transversos, sese decussantes, gerentibus; anfractibus cæteris unico sulco transverso prope margines suturales exaratis, marginibus ad spiram adpressis; peripheriá anfractuum primo convexá, deinde gradatim plus plusque rotundatá: aperturá elongato-rhomboidali, antice profunde emarginatá, postice sub-canaliculatá; labro postice incrassato, antice acuto, lævi; labio parum effuso, incrassato, postice magnum callum oblongum, anfractum a spirá separantem, formanti; columellá leviter arcuatá, compressá, buplicatá.

Shell ovately turbate, ventricose; spire short, conical, with a small, pointed apex; the first two or three whorls ornamented with numerous slender longitudinal ribs decussated by transverse furrows, which disappear rather suddenly at the third whorl; the whorls then become perfectly smooth, except towards the base, where they are traversed by broad more or less conspicuous furrows. The aperture is of an elongated rhomboidal form, deeply notched in front, and terminating posteriorly in an obscure channel; the outer lip smooth within, thickened behind, and stretching outwards into a wing-like projection; the middle and front parts thin and sharp-edged; the columellar lip but little spread out, and very much thickened, forming at the posterior extremity a large callus, which gradually separates the margins of the whorls more and more widely from the spire; the columella is curved, flattened, and furnished with two oblique, nearly equal folds, and sometimes with a third feeble and indistinct one behind. The middle whorls are convex at the shoulders, but as they become more and more detached from the spire by the increasing callus, the shoulders become more and more bluntly round.

The shells referred by Mr. Sowerby to *V. bulbula* are without doubt the young of the present species; but even in this state (figs. 2 *a, b*), although they much resemble the French shells, they present dissimilarities which sufficiently indicate a distinct species. In *V. bulbula*, the shell is more fusiform, with a longer spire; the margins of the whorls are without the transverse furrow; the outer lip, even in the adult shell, is not thickened; the inner-lip is very thin, more widely spread over the body-whorl, and without the thickening or callus which distinguishes the present species; the columella is nearly straight and round; the folds are more slender, and placed nearer the middle of the

columella, and the basal furrows are fainter and more numerous, becoming, in fact, almost obsolete on the mature shell.

The present species certainly presents a close analogy with *V. labrella* (Lamk.) to which the adult shells have been referred; but a careful comparison will show, I think, that they are not a mere local variety of that species, but distinct from it. In *V. Selseiensis*, the whorl is more convex, and the general form of the shell is consequently more ovate and less turbate; the shoulder is always obtusely rounded, and never presents the prominent keel which characterises *V. labrella*, nor even the angular periphery which, in some specimens, is substituted for the keel; the transverse furrows are lost after the very early whorls, while in the French species they are continued more or less distinctly until maturity. But the principal differences will be found in the condition of the lips; for in *V. labrella*, the outer lip is much less thickened, and does not assume the wing-like expansion found in the present species; the inner lip is more widely spread over the front of the body-whorl and, although thickened at the posterior extremity, does not form the large callus which, by separating the margin of the whorl from the spire, forms so conspicuous a character in *V. Selseiensis*.

Size.—Axis, 2 inches and 7-10ths nearly; diameter, rather more than 1 inch and 6-10ths.

Locality.—Bracklesham Bay, where it is not uncommon.

Section A. (Pullus small, conical) continued.

b. Shell fusiform; costated, transversely striated; inner lip narrow.

a. Columellar plaits few.

No. 108. *VOLUTA ANGUSTA. Deshayes. Tab. XXIII, figs. 3 a, b.*

VOLUTA ANGUSTA, Desh. 1824-37. Desc. des Coq. Foss., vol. ii, p. 697; t. 94, figs. 5, 6.

— — *Sow.* 1844. Min. Con., vol. vii, p. 34, t. 626, figs. 1—3.

— — *Sow.* 1850. Dixon's Geol., &c., of Suss., p. 107, t. 5, fig. 19 (non t. 7, fig. 37).

V. testá elongatá, sub-fusiformi, angustá, costatá, ad basin late emarginatá; spirá productá sub-conicá, apice acuto: anfractibus depresso-convexiusculis, superne tenuissime striatis; ultimo anfractu spiram longitudine fere æquantis; postice tuberculoso-costatá, ad basin lævi: aperturá elongatá, angustá; columellá rectá, obscure triplicatá; labro acuto, simplici; labio angusto.

Shell fusiform, much elongated, narrow, ribbed, and widely but not very deeply notched at the base; spire conical, produced, nearly as long as the last whorl; apex small, pointed: whorls depressedly convex; ornamented with exceedingly fine transverse striæ; ribs distant, not prominent, extending to nearly the middle of the whorl, and

rising at the shoulder into obtuse laterally compressed tubercles; the transverse striæ are lost on the middle and front parts of the last whorl, and are only faintly traceable towards the sutural margin. The aperture is elongated, narrow, with nearly parallel margins; the outer lip simple, sharp-edged, angular at the posterior extremity, smooth within; inner lip narrow; the columella is nearly straight, and, according to M. Deshayes, is furnished with three folds, of which one only is visible in front, but the other two are seen when the outer lip is broken.

The much-varying forms of *V. muricina*, suggested to M. Deshayes the probability that this might eventually prove to be merely a narrow variety of that species, to which in fact it bears a very strong resemblance: the transverse striation is common to both species, and much value, cannot, I think, be attributed to the greater or less number of the feeble posterior columellar folds. I should be strongly inclined, therefore, to regard this as a variety of *V. muricina*, were it not for the difference in the size of the pullus, which, in *V. angusta*, is much smaller than in *V. muricina*; and, as it is uncertain how far external conditions may influence the development of the shell in embryo, I have retained the species.

The shell represented in Mr. Dixon's work, t. 7, fig. 37, does not, in my opinion, belong to this species; for the pullus, though small, is obtuse, not conical and pointed; and the notch is very deep: it is, I think, a large specimen of *V. uniplicata*.

Size.—Axis, 3 inches nearly; diameter, 9-10ths of an inch.

Localities.—Bracklesham Bay. *French*: Rétheuil, Soissons, Cuise-Lamotte, (fide Desh.)

No. 109. *VOLUTA COSTATA*. Solander. Tab. XXII, figs. 5 a—d.

VOLUTA COSTATA, Soland. 1766. Brand. Foss. Hant., p. 24; t. 3, fig. 45.

— — Sow. 1821. Min. Con., vol. iii, p. 163; t. 290, figs. 1 (non figs. 2 and 4).

Nec — — Grat. 1847. Conchyl. foss., &c. de l'Adour; Supp. t. 1, fig. 14a—b.

nec — — Sow. 1850. Dixon's Geol. &c., of Suss., p. 107; t. 5, fig. 24.

V. testá ovato-fusiformi, costatá, lineis transversis ornatá; spirá elevatá, conicá; apice acuto: anfractibus convexiusculis; costis angustis inermibus; aperturá oblongo-ovali, ad basin sub-profunde emarginatá; labro simplici, tenui; labio angusto; columellá sub-rectá, quadri-plicatá.

Shell ovately fusiform, longitudinally ribbed and ornamented with numerous transverse raised lines; spire conical, elevated, being as long or nearly as long as the aperture, and terminating in a small pointed pullus; whorls six or seven, exclusive of the pullus, and rather convex; the ribs simple, narrow, sharp, slightly curved and extending to the base, numerous on the early whorls, but becoming more distant as the shell is enlarged. The transverse lines, which are decussated by the lines of growth, are very slender, and irregular; every third or fourth line being thicker and more

elevated than the others, except towards the base, where the more prominent lines are placed nearer to each other, and the intermediate ones become very faint or altogether obsolete.—Aperture of an oblong-oval form, rather deeply notched in front; outer lip simple, sharp-edged and smooth within; inner lip very narrow, and thin; columella nearly straight, and furnished with two oblique folds in front, and two or three slender, obscure ones behind.

Brander's specimen in the British Museum, is unfortunately mislaid, and I have not been able to refer to it; but, judging from the description and figure given in his '*Fossilia Hantoniensia*,' the present Volute must be the true *V. costata* of Solander; for the word *inermis*, used by that naturalist in his description, cannot be applied to the shells, distinguished by the thick nodiform terminations of their ribs, which have been referred by Mr. Sowerby to that species.

D'Orbigny (Prod. de Paléont., vol. ii, p. 352, No. 267) has recorded this Volute as identical with the *Cochlea mixta* of Chemnitz, (*V. costaria*, Lamk.); but in that species the shell is longer and narrower, the surface quite smooth, except at the base; and the columella curved and furnished with two folds only. The two shells appear to me to be quite distinct from each other.

The shell from Bracklesham Bay figured in Mr. Dixon's work (t. 5, fig. 24) as *V. costata*, is a specimen of *V. Maga*; and those from Dax and Saubrigues, which Grateloup has considered to be identical with Solander's shell (fig. 45) appear to belong to a different species; they are represented as sub-turreted, with numerous rounded ribs, and with many folds on the columella, extending nearly to the posterior extremity of the aperture.

Size.—Axis, 2 inches nearly; diameter, 8-10ths of an inch nearly.

Locality.—Barton.

No. 110. VOLUTA HUMEROSA. *F. E. Edwards*. Tab. XXII, figs. 6 *a*, *b*.

VOLUTA COSTATA. *Sow.* 1821. Min. Con., vol. iii, p. 163; t. 290, figs. 2 and 4 (non fig. 1.)

Testá ovato-fusiformi, sub-turritá, costatá, transversim tenuissime lineatá, ad basin profunde et late emarginatá; spirá productá, apice acuto: anfractibus sub-planis; costis distantibus, crassis, rotundatis, postice nodigeris; aperturá ovato-rhomboidali, postice sub-canaliculatá; labro incrassato, intus lævi; labio angusto, crasso; columellá flexuosá, bis vel ter plicatá.

Shell ovately fusiform, sub-turreted, longitudinally ribbed, transversely finely striated; the base deeply and widely notched, and much bent backwards; spire elevated, but shorter than the last whorl; apex small, pointed: whorls five or six, exclusive of the embryonic whorls, very slightly convex, and flattened at the sides; ribs distant, broad, obtuse, reaching almost to the base, and at the posterior extremities

swelling into large, rounded tubercles. Aperture ovately rhomboidal, terminating behind in a narrow, but conspicuous, channel; outer lip smooth within, thickened towards the suture, otherwise thin and sharp-edged; inner lip narrow, thick, particularly at the posterior extremity, where it forms almost a callus; columella curved, and furnished with two prominent folds in front, and sometimes a third faint one behind.

The Volutes which I propose to separate under the present specific name, have been confounded hitherto with the preceding species (*V. costata*, Sol.); they appear, however, to be specifically distinct. The shells are broad, obtusely angulated at the shoulders, with flattened sides; the ribs are more distant, thicker, and rounder, and on the last two whorls rise at the shoulder into large tubercles; the transverse lineation is more regular, and the aperture wider, and not contracted behind; the inner lip is much thicker, the columella more curved, and furnished with two folds, or, occasionally only, with a third faint one behind; and the base is much more bent backwards, owing to the deeper anterior notch. Specimens occasionally occur in which, owing to the tubercles being less prominent than usual, the spire is more regular in form, and the shells present a general resemblance to *V. costata*; but the whorls still preserve the flatness of the sides, and the ribs their characteristic roundness; and the condition of the columella and the inner lip show, in fact, that the individuals in question are merely a variety of the present species.

Size.—Axis, 2 inches and 2-10ths; diameter, 1 inch and 1-10th nearly.

Localities.—Barton, and Bracklesham Bay.

Section A. (*Pullus small, conical.*

b. Shell fusiform; costated, transversely striated; inner lip narrow) } *continued.*

β. Columellar plaits numerous.

No. 111. VOLUTA MAGA. *F. E. Edwards.* Tab. XXII, figs. 2 a—f.

VOLUTA MAGORUM. *Sow.* 1821. Min. Con., vol. iii, p. 164; t. 290, fig. 3.

— — *Morris.* 1843. Cat. Brit. Foss., p. 168.

— HARPULA. *Sow.* 1840. Min. Con., vol. vii, p. 7; t. 614, fig. 1.

— — *Morris.* 1843. Cat. Brit. Foss., p. 167.

— COSTATA. *Sow.* 1850. Dixon's Geol., &c., of Suss., p. 107, t. 5, fig. 24.

— MAGNORUM (ex errore). *D'Orb.* 1850. Prod. de Paléont., vol. ii, p. 353, No. 281.

— DECORA? *Beyr.* 1853. Die conchyl. des Norddeut. tertiarg. vol. i, p. 73; t. 4, figs. 5 a—b.

Nec. — MAGORUM. *Brocc.* 1814. Conchol. foss., Subapen., vol. ii, p. 307; t. 4, fig. 2.

nec. — HARPULA. *Lamk.* 1802. Ann. du Mus., vol. i, p. 478, No. 9, and vol. xvii, p. 78, No. 13.

V. testá ovato-fusiformi, unduloso-costatá, inermi, transversim tenuissime striatá, ad basin profunde emarginatá; spirá obtusá; apice sub-acuto; anfractibus sex vel septem,

depresso-convexis: aperturá oblongo-ovali, antice effusá; labro ad marginem tenui, acuto, intús incrassato; labio angustissimo, crasso; columellá leviter arcuatá, pluries plicatá, plicá penultimá majori.

Shell ovately fusiform, ribbed, transversely furrowed, deeply notched, and bent backwards at the base; spire elevated, obtuse, with a small conical pullus; whorls six or seven, exclusive of the embryonic shell, convex, flattened at the sides, and separated by a deep suture. Ribs numerous, thick, rounded, slightly waved, and prolonged to the base; transverse furrows shallow, irregular, becoming faint, frequently almost obsolete, over the middle of the whorl. Aperture of an oblong-oval shape, wide in front, narrowing behind; outer lip simple, sharp-edged, and thickened within; inner lip very narrow, thick; columella slightly curved and furnished with ten or twelve folds, of which the front one is very oblique and moderately prominent, and the last but one larger and more transverse; the others rise almost to the suture, becoming feebler and more transverse as they ascend the columella. The ridge or crest on the columella, found in all the deeply notched species, is half concealed by the thick inner lip, but bulges out beyond the contour of the whorl.

The specimen of *V. magorum* figured by Brocchi was imperfect, and his description is short and unsatisfactory; it is, therefore, difficult to decide whether the shells described by Mr. Sowerby have been correctly referred by him to the Subapennine species. Judging, however, from Brocchi's figure and description, the *V. magorum* appears to be a more regularly convex shell, attenuated more equally at the extremities, and to have a more conical spire than the English shells. It is stated, also, to be smooth; but much reliance cannot be placed on this character, for Brocchi describes the shell as *convertita in ispato*, and the transverse furrows may have become obliterated in that process. The ribs are more numerous, and are slender and straight; the columellar folds also are more oblique, and the three front ones are nearly equal. The aperture appears to have been but slightly notched in front, inasmuch as the uninterrupted contour of the body whorl does not present the ridge caused by the retroflexion of the base, which always accompanies a deep notch. These distinctions, I think, show that the English shells, although closely allied to, are yet distinct from, Brocchi's species, or at all events that they cannot be safely considered as belonging to it.

The shells (figs. 2 *a, b*) referred by Mr. Sowerby to *V. harpula* (Lamk.), are only young shells of the present species, and are distinguished from the French species as well by the transverse striation as by the shorter and more obtuse spire, the more distant, thicker, and rounded ribs, the thinner outer lip, and the greater obliquity of the columellar folds.

Dr. Beyrich (*loc. cit.*) has described a Volute from Westeregeln (*Voluta decora*) which resembles the present species so closely that it is difficult to separate the two. The chief differences appear to be that the transverse striation is perceptible on the

spire only, just below the suture, and on the front half of the body whorl; the whorls, although described as "almost flat," appear from the figure to be roundedly convex, and to be contracted towards the base, the columella is without the ridge, the presence of which evidences a deep notch, and the columellar folds appear to be nearly equal in size. In all other respects the two species agree. As to the transverse striation, that character becomes feeble on the last whorl of some of the English shells, and the absence of it in the only specimen of *V. decora*, possessed by Dr. Beyrich, and from which his description is taken, may be due to an imperfect preservation of the surface; the only difference, in fact, of specific value, is the character of the notch. Dr. Beyrich himself expresses great doubt whether the *V. magorum* of Sowerby is the same as his shell, and, without an actual comparison of the shells, I cannot venture to affirm their identity. If they should prove to belong to the same species, the name *V. decora* imposed by Dr. Beyrich will supersede the one I have given.

Individuals of the present species occur, although very rarely, at Bracklesham Bay, and usually retain traces of their ornamental colouring, consisting of numerous dark brown transverse bands, which I have not found in specimens from other localities.

Size.—Axis, 2 inches and 3-10ths; diameter, 1 inch.

Localities.—Barton, Highcliff, Alum Bay (Strat. No. 29, Prestw.), Bracklesham Bay.
German: Westeregeln in Magdeburgh (fide Beyrich)?

No. 112. *VOLUTA BRANDERI*. *Deshayes*. Tab. XXII, figs. 4 a, b.

VOLUTA BRANDERI. *Desh.* 1824—37. *Descr. des Coq. foss., &c.*, vol. ii, p. 701; t. 90, figs. 15—16.

— — *Defr.* 1829. *Dict. des Sci. nat.*, vol. lviii, p. 477.

V. testá ovato-oblongá, turritá, longitudinaliter costatá, cæterum lævi; spirá mediocri, acuminatá, apice acuto: anfractibus convexiusculis; costis crassis, rotundatis: aperturá elongatá, angustá, ad basin profunde emarginatá; labro incrassato, simplici; labio angusto; columellá triplicatá et rugis transversalibus instructá.

Shell oval-oblong, turreted, longitudinally ribbed, otherwise smooth; spire moderately elevated, and terminating in a small, conical pullus: whorls six or seven, slightly convex; ribs rather numerous, thick, round, extending in front almost to the base, and prolonged backwards to the very edge of the whorl, where they terminate abruptly, forming, with their truncated extremities, a flattened ledge, which gives a turreted aspect to the spire. The only specimen I possess consists of the spire, the front part of the shell being broken away; but in the French shells the whorls are traversed at the base by several undulating striæ; the aperture is of a lengthened oval shape, deeply notched in front; the outer lip is much thickened, and smooth within; the inner lip is narrow, and the columella presents three moderately oblique folds in front,

of which the middle one is the largest and most prominent, and several transverse raised lines behind. Fig. 4 *b*, taken from a French specimen, is introduced for comparison, and to shew the perfect shell.

In general appearance, this Volute resembles *V. maga*; but it is quite smooth excepting where a few faint lines traverse the base; the spire is turreted, more slender, and tapering; and the ribs more numerous and more prominent.

Mr. Sowerby has described* a Volute from the tertiary formation in Cutch (*V. dentata*), which somewhat resembles the present species; but the ribs terminate posteriorly in erect, pointed tubercles, the surface of the shell is concentrically striated, the outer lip is plicated within, and the columella presents only two, nearly equal, prominent folds.

Size.—According to M. Deshayes, axis, 1 inch and a half; diameter, three-quarters of an inch.

Localities.—Bracklesham Bay. *French*: Monneville, Valmondois (fide Desh.); Les Clergis, Acy (fide D'Orb.).

No. 113. *VOLUTA PROTENSA*. Sowerby. Tab. XXIII, figs. 5 *a—c*.

VOLUTA PROTENSA. Sow. 1840. Min. Con., vol. vii, p. 5; t. 612, figs. 6, 7.

V. testá fusiformi, protensá, transversim striatá, in juventá obscure costatá; spirá acuminatá, apice acuto: anfractibus convexiusculis, ad margines suturales depressis: aperturá angustá, profunde emarginatá; labro simplici, tenui, acuto; labio angusto; columellá pluries plicatá.

Shell fusiform, elongated, transversely striated, obscurely ribbed in the young state; spire elevated, being as long as the aperture, and terminating in a small, pointed apex: whorls six or seven, rather convex, depressed round the sutural margin, and having the edge pressed against the spire: aperture narrow, deeply notched at the base; outer lip simple, thin, and sharp-edged; inner lip very narrow; columella straight, furnished with six or seven distant oblique folds ascending to the top of the columella; the fold in front is the largest and most prominent, the others thread like, and nearly equal.

This appears to be a well-marked species, quite distinct from all the other Eocene Volutes.

Size.—Axis, 2 inches; diameter, 6-10ths of an inch.

Localities.—Chalk Farm, Whetstone, Potter's Bar.

* Grant's Geology of Cutch, Geol. Trans., 2d series, vol. v, p. 322; t. 25, fig. 26.

*Section B. Pullus sub-papillary.**a. Shell pyriform; inner lip effuse; columella plaits few.*No. 114. *VOLUTA CITHARA. Lamarck. Tab. XXIII, figs. 6 a—c.**Henckel. 1760. Pyrotol., t. 5, fig. 9.**Favanne. 1780. D'Argenv. Conchyl. (3d edit.), t. 166, fig. 4.**Burtin. 1784. Oryctogr. de Bruxelles, t. 15, D.**CITHARÆDUS. Chemn. 1795. Conchy. cab., vol. xi, t. 212, figs. 2098, 2099.**VOLUTA HARPA. Lamk. (non LINN). 1802. Ann. du Mus., vol. i, p. 476, No. 1; and vol. xvii, p. 74, No. 1.*— *CITHARA. — 1816. Tab. Encyclop. et method., t. 324, figs. 1 a, b.*— — — 1822. *Hist. nat., &c., vol. vii, p. 346, No. 1.*— — — *De France. 1829. Dict. des Sci. nat., vol. lviii, p. 474.*— *HARPA. Desh. 1833. Encycl. method. (Vers), vol. iii, p. 1143, No. 21.*— *CITHARA. Desh. 1824—37. Descr. des Coq. foss., &c, vol. ii, p. 681; t. 90, figs. 11, 12.*— — — *Sow. 1842. Min. Con., vol. vii, p. 31; t. 625, figs. 1—3.*— — — *Nyst. 1843. Desc. des Coq., &c., de la Belg., 590, No. 508.*— — — *Sow. 1850. Dixon's Geol., &c., of Suss., p. 106; t. 5, fig. 17.*— *CYTHARA. D'Orb. 1850. Prod. de Paléont, vol. ii, p. 353, No. 277.*

V. testá ovato-oblongá, costatá, postice lævi, antice coarctatá, transversim sulcatá, late emarginatá; spirá brevi, sub-muricatá, apice sub-papillari: anfractibus convexis, ventricosus; costis distantibus, postice bispinosis: labro tenui, lævi; labio antice expanso; columellá quinquies plicatá.

Var. ANGULATA (fig. 6 b) testá breviori, latiori, costis numerosioribus; anfractibus angulatis, unicá serie spinarum coronatis.

Shell ovate-oblong ventricose, contracted in front, ribbed, smooth except towards the base, where it is transversely furrowed; spire short, armed with short spines; apex conical, sub-papillary: whorls convex, rounded at the shoulder; ribs distant, extending to the middle of the whorls, crowned with two or three rather blunt, nodiform spines, which are lost on the last whorl of the fully formed shell. The aperture is effuse, and widely notched in front; the right lip is thin, sharp-edged, smooth within; the columellar lip thin, widely spread over the front part of the body whorl; columella furnished with one prominent very oblique fold in front, and three or four smaller ones behind.

The English specimens agree perfectly with the French shells, and the examination of a longer series of specimens than that to which Mr. Sowerby had access, shows that individuals occur here, as well as in France, having the spire considerably produced (fig. 6 a).

A short variety, (fig. 6 *b*), is also found, in which the whorls are angulated at the shoulder, the ribs are shorter, more numerous, and crowned with single, sharp, erect spines.

Size.—Axis 4 inches ; diameter, $2\frac{1}{4}$ inches.

Localities.—Bracklesham Bay. *French* : Grignon, Courtagnon, Parnes (fide Desh.), Hattencourt, Hermes (fide D'Orb.). *Belgian* : Brussels, Panisel, near Mons (fide Nyst).

Section B. (Pullus sub-papillary) continued.

b. Shell fusiform ; inner lip narrow ; columellar plaits few.

No. 115. *VOLUTA UNIPLICATA*. *Sowerby*. Tab. XXIII, figs. 2 *a—c*.

VOLUTA UNIPLICATA. *Sow.* 1850. *Dixon's Geol., &c., of Suss.*, pp. 107 and 188, t. 7, figs. 45, 46.

— *ANGUSTA*. *Sow.* 1850. *Idem.*, t. 7, fig. 37.

V. testá fusiformi, obsolete costatá, in juventá transversim tenuissime striatá, ad basin obscure sulcatá, profunde emarginatá ; spirá conicá, apice sub-papillari ; anfractibus depresso-convexiusculis, obtuse angulatis ; aperturá oblongo-ovali ; labro incrassato, intus lævi ; labio angusto, crasso ; columellá leviter arcuatá, uniplicatá.

Shell fusiform, faintly ribbed, obscurely sulcated towards the base, and deeply notched in front ; spire elongated and nearly conical ; pullus sub-papillary : whorls rather convex, flattened at the side, and obscurely angulated at the shoulder ; in the young state they are ornamented with crowded, very fine, transverse striæ. The ribs are prominent, thick, rounded, and produced nearly to the base ; but on the last two or three whorls they become obsolete, and are replaced by a row of obscure, blunt tubercles placed on the angle of the shoulder ; the transverse striation is also lost, and the body whorl is smooth, except where the shallow, faint, basal furrows appear ; the aperture is of a lengthened oval shape ; the outer lip thickened near the suture, rather sharp-edged towards the front, and smooth within ; the inner lip narrow and thick ; the columella slightly curved, and furnished with one prominent fold, placed nearer to the anterior extremity than is usually the case.

Fig. 2 *a* is taken from the shell figured in Mr. Dixon's work (t. 7, fig. 37) as *V. angusta*.

This species, which appears to be well characterised, is not uncommon.

Size.—Axis, 3 inches nearly ; diameter, 9-10ths of an inch.

Locality.—Bracklesham Bay.

No. 116. *VOLUTA MURICINA*. *Lamarck*. Tab. XXIII, figs. 1 *a—c*.

			<i>Lister</i> . 1685. Hist. Conchyl., t. 1033, fig. 6 ?
			<i>Favanne</i> . 1780. D'Argenv. Conchyl. (3d edit.), t. 66, fig. 1.
COCHLEA MIXTA ?			<i>Chemn.</i> 1795. Conchyl. cab., vol. xi, t. 212, figs. 3010—3011.
VOLUTA MURICINA.	<i>Lamk.</i>	1816.	Tableau Encyclop. et méth., t. 383, fig. 1 <i>a—b</i> .
—	—	—	1802. Ann. du Mus., vol. i, p. 477, No. 4; vol. xvii, p. 75, No. 5.
—	—	—	1822. Hist. nat., &c., vol. vii, p. 350, No. 5.
—	—	<i>Defr.</i>	1829. Dict. des Sci. nat., vol. lviii, p. 475.
—	—	<i>Desh.</i>	1833. Encyl. méth. (Vers), vol. iii, p. 1144, No. 24.
—	—	—	1824—37. Descr. des Coq. foss., &c., vol. ii, p. 697; t. 91, figs. 18—19; t. 93, figs. 3—4; t. 94, figs. 3—4.
—	—	<i>Sow.</i>	1844. Min. Con., vol. vii, p. 31; t. 626, figs. 4—6.
—	—	—	1850. Dixon's Geol., &c., of Suss., p. 107; t. 5, fig. 20.

V. testá ovato-fusiformi, ad basin sub-productá, late emarginatá, antice lævi, postice longitudinaliter tuberculato-costatá; spirá elongatá, apice obtuso: anfractibus angulatis, in juventú tenuissime transversim striatis, ultimo anfractu spiram in longitudine vix superanti: aperturá oblongo-ovatá; labro simplici; labio angusto; columellá ter vel quater plicatá, inter plicas anteriores sulco lato exaratá.

Shell ovately fusiform, produced, and widely, but not deeply, notched at the base; spire long and pointed, with a sub-papillary apex; whorls six or seven, obscurely furrowed at the base, smooth elsewhere, wide and angulated at the shoulder, crowned with a single row of pointed, pyramidal tubercles, having their bases prolonged into obtuse ribs, which are lost about the middle of the whorl; the last whorl is conical, and rather longer than the spire. In the immature shell the whorls are ornamented with numerous, very slender, transverse striæ, which are lost as the shell approaches maturity. The aperture is of an oblong oval shape; outer lip rather thick, with a blunt margin; inner lip narrow, thickened; columella round, curved, furnished with one large, prominent fold in front, and two or three smaller folds behind, and deeply furrowed between the two front folds.

The ribs sometimes, particularly in young specimens, extend far down the whorl, almost to the base, and the tubercles are rounded: specimens also occur which are narrower, and more slender than the typical form; and, again, others are found wider and shorter, according to the condition of the ribs. Indeed, as both *M. Deshayes* and *Mr. Sowerby* have remarked, the shell is so variable in this respect, as to render it difficult to define. The transverse striation is found as well on the French as on the English shells, although that character is not noticed either by *Lamarck* or *Deshayes*.

Size.—Axis, 3 inches and 4-10ths; diameter, 1 inch and 6-10ths.

Localities.—Bracklesham Bay. *French*: Grignon, Parnes, Mouchy, Courtagnon (fide *Desh.*), Chaumont (fide *D'Orb.*).

*Section C. Pullus papillary.**a. Shell fusiform ; inner lip effuse ; columella plaits few.*No. 117. *VOLUTA WETHERELLII. Sowerby. Tab. XXIII, figs. 4 a—d.**VOLUTA WETHERELLII. Sow. 1836. Lond. and Edinb. Phil. Mag., and Journ. of Science, 3d ser., vol. ix, p. 463, note.*— — *Sow. 1840. Min. Con., vol. vii, p. 5 ; t. 612, figs. 1—5.*

V. testá fusiformi, elongatá, ad basin parum emarginatá? in juventá concentricè lineatá, deinde lævi ; lineis confertis, subtilissimis ; spirá conicá, apice papillari : anfractibus sex vel septem, convexis, marginibus ad spiram adpressis : aperturá elongato-ovalí ; columellá subrectá, triplicatá ; labro ? ; labio effuso.

Shell fusiform, elongated, slightly produced in front ; spire conical, elevated, and terminating in an obtuse papillary apex : whorls six or seven, convex, with the margins pressed against the preceding volutions, and presenting a broad, shallow depression, which runs round the spire between the shoulder and the suture. The earlier whorls are ornamented with numerous concentric raised lines ; these lines are much crowded, and so very fine as to be scarcely visible by the naked eye, and do not detract from the apparently even surface ; the last whorl is smooth. Aperture of a lengthened oval form, columella nearly straight, and furnished at maturity with moderately oblique folds, of which the one in front is the smallest, and that in the middle the largest ; inner lip widely spread over the body-whorl, but not extending backwards beyond the suture ; the base, apparently, but slightly notched, as the columella does not present any prominent ridge. The outer lip is not preserved in any specimen I have seen.

This Volute presents a remarkably close analogy with the well-known Crag species *V. Lamberti* ; but it is a longer, narrower shell, with a much smaller pullus ; and the columella presents three unequal folds instead of the four nearly equal folds which characterise that species. It appears to be confined to the lower formations in the neighbourhood of London, and has not as yet been found, I believe, at Highgate.

Size.—The actual dimensions cannot be stated accurately ; those of the largest of the specimens figured must have been, axis, 5 inches, nearly ; diameter, 1 inch and 8-10ths, nearly.

Localities.—Camden Town, Chalk Farm, Haverstock Hill, Hornsey, Copenhagen Fields, Holloway, Whetstone, Potter's Bar, Bayswater, Brentford, Sheppey.

Genus 24th. MITRA.* *Lamarck*. 1801.MITRA, TURRIS, *Montf.*, 1810.CYLINDRA, IMBRICARIA, *Schum.*, 1817.TIARA, MITREOLA, CONELIX, MITRELLA, *Swains.*, 1840.VULPECULA, *Gray*, 1840.

Gen. Char.—Shell fusiform, smooth, longitudinally ribbed or cancellated; spire elevated, pointed: aperture longitudinal, narrow, notched at the base, and without a canal, or at most with a very short one; outer lip sometimes thickened, generally sharp-edged, internally smooth or crenulate; columella plaited, folds regular, nearly transverse, the anterior one the smallest.

The Mitres are distinguished from the Volutes, with which they had been associated until they were separated by Lamarck, by their more elongated, less ventricose form, and by the character of the columellar plaits, which are more transverse and regular, with the smaller one in front, a disposition the reverse of that which characterises the Volutes.

The animal has a small, narrow head, with short, pointed tentacles, on the external sides or bases of which the eyes are placed; but some species from the Mediterranean, according to M. Deshayes, bear pedicels much shorter than the tentacles, united to them, and terminated by the ocular points. The foot is narrow, truncate in front, pointed behind; and the anterior margin of the mantle is produced into a short, cylindrical canal. But that which chiefly distinguishes the animal of *Mitra*, is the great length of the proboscis, which, in some species, considerably exceeds that of the shell.

The Mitres, as defined by Lamarck, have been subdivided into several genera, dependent chiefly on conchological distinctions. In some of these divisions the animals, according to observations recently made by Dr. Gray, exhibit modifications of the lingual teeth closely resembling those characteristic of other genera; and that eminent naturalist, therefore, regards the *Mitræ* as forming a family distinct from the *Volutidæ*, with which they have usually been associated. The small, narrow foot, and elongated proboscis lead, apparently, to the same conclusion.

The living *Mitræ* are very numerous; upwards of 350 species being known; of these one is from the coast of Greenland, and some few small species are found in the Mediterranean. With these exceptions, the *Mitræ* are confined to tropical or sub-tropical seas, where they are found, according to Messrs. Adams, chiefly on the shores of islands, but few species inhabiting continental shores. They appear to be deep-sea molluscs, most of the species ranging in depth from 15 to 80 fathoms, although some few are littoral.

* Etym. *Mitra*, a turban or covering for the head, worn by the Persians and other Asiatics.

TAB. XVI.

Fig.

1. *Cypræa oviformis*. No. 71*, p. 128.
 - a. Back view, adult shell from Primrose Hill.
 - b. Front view of the same.
 - c. Front view, adult shell from Highgate.
 - d. Front view, adult shell (globose var.) from Whetstone.
 - e. Back view, young shell (first stage) from Barnett.
 - f. Front view of the same.
 - g. Side view, (shell in second stage), from Potter's Bar.
 - h. Side view, adult shell, showing the inner whorls.
 - i. Original specimen from the well on Hampstead Heath, described as *Ovulum retusum*.
2. *Cypræa tuberculosa* (Var. *Coombii*). No. 75, p. 131.

Front view.
3. *Cypræa globularis*. No. 73, p. 130.
 - a. Back view.
 - b. Front view.
4. *Cypræa inflata*. No. 71, p. 126.
 - a. Back view.
 - b. Front view.

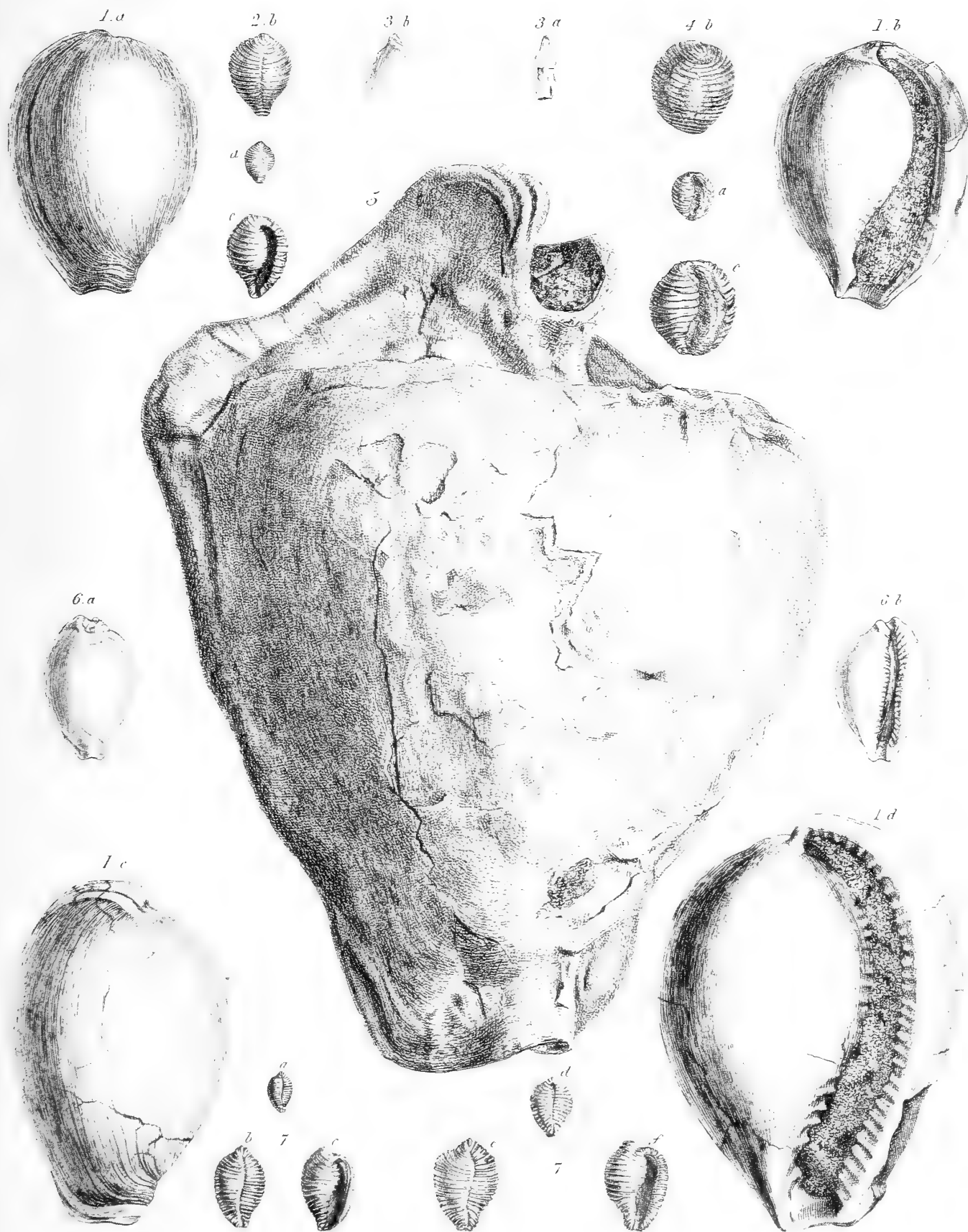


TAB. XVII.

Fig.

1. *Cypræa Bowerbankii*. No. 72, *p.* 129.
 - a.* Back view, shell from Highgate.
 - b.* Front view of the same.
 - c.* Back view, shell from Bracklesham Bay.
 - d.* Front view, ditto.
2. *Cypræa Prestwichii*. No. 78, *p.* 134.
 - a.* Back view, natural size.
 - b.* Back view of the same, magnified.
 - c.* Front view of the same, ditto.
3. *Ovula? antiqua*. No. 79, *p.* 136.
 - a.* Back view, natural size.
 - b.* Back view of posterior extremity, magnified.
4. *Cypræa Wetherellii*. No. 77, *p.* 133.
 - a.* Front view, natural size.
 - b.* Back view of the same, magnified.
 - c.* Front view of the same, ditto.
5. *Cypræa tuberculosa*, (Var. *Coombii*). No. 75, *p.* 131.

Back view.
6. *Cypræa Bartonensis*. No. 74, *p.* 130.
 - a.* Back view.
 - b.* Front view.
7. *Cypræa platystoma*. No. 76, *p.* 132.
 - a.* Back view of young shell, natural size.
 - b.* Back view of the same, magnified.
 - c.* Front view of the same, ditto.
 - d.* Back view of adult shell, natural size.
 - e.* Back view of the same, magnified.
 - f.* Front view of the same, ditto.

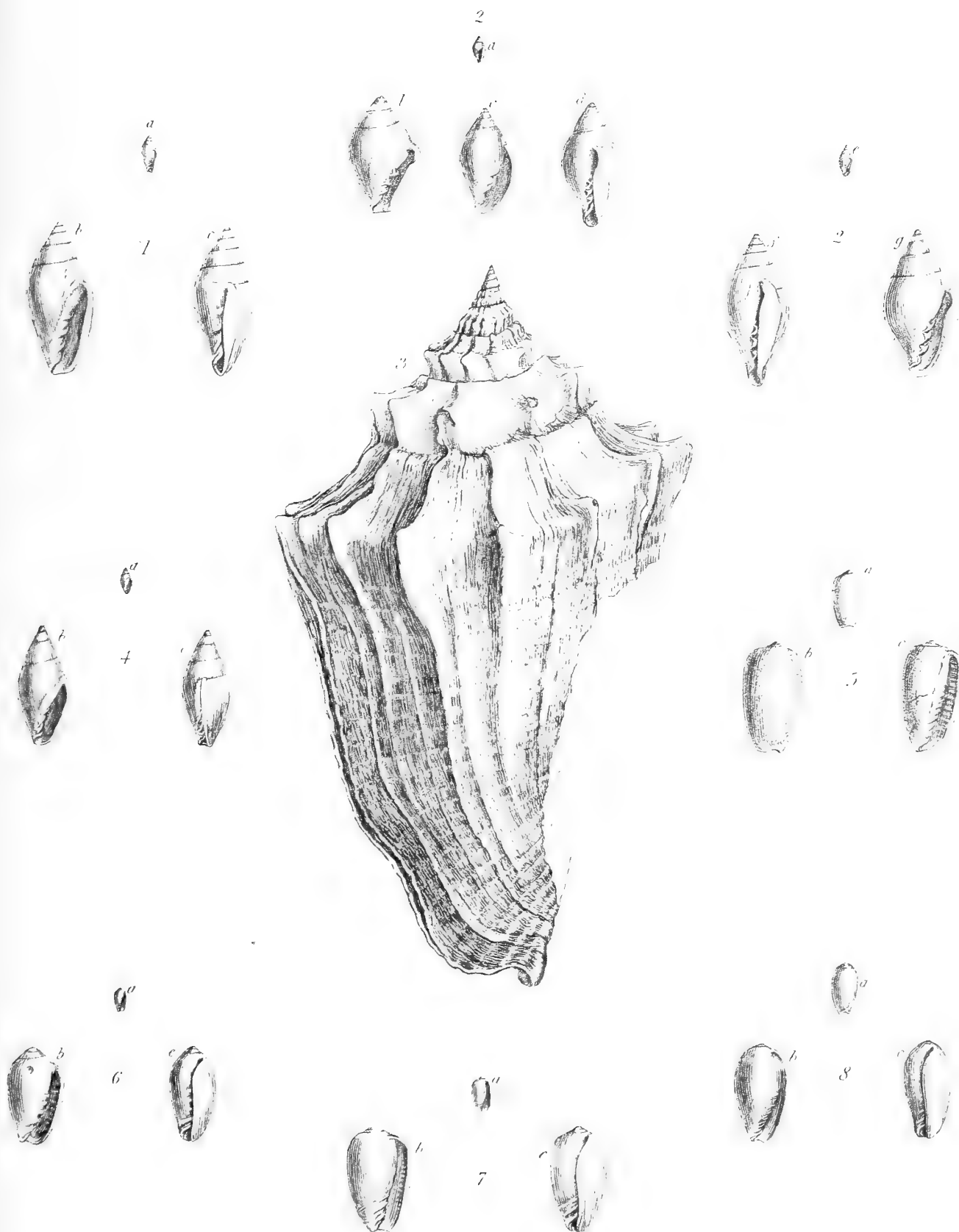


TAB. XVIII.

Fig.

1. *Marginella eburnea*. No. 80, *p.* 137.
 - a.* Front view, natural size.
 - b.* Front view, magnified.
 - c.* Side view, ditto.
 2. *Marginella bifido-plicata*. No. 81, *p.* 139.
 - a.* Front view of adult shell from Barton, natural size.
 - b.* Front view of the same, magnified.
 - c.* Front view of young shell, from ditto, ditto.
 - d.* Side view of adult shell, ditto, ditto.
 - e.* Front view of adult shell, Var. from Alum Bay, nat. size.
 - f.* Side view of the same, magnified.
 - g.* Front view of the same, magnified.
 3. *Voluta luctatrix*. No. 87, *p.* 147.

Back view, adult shell.
 4. *Marginella gracilis*. No. 82, *p.* 140.
 - a.* Front view, natural size.
 - b.* Front view, magnified.
 - c.* Side view, ditto.
 5. *Marginella ovulata*. No. 83, *p.* 141.
 - a.* Back view, natural size.
 - b.* Back view, magnified.
 - c.* Front view, ditto.
- Note.*—The posterior extremity of the outer lip is imperfect.
6. *Marginella pusilla*. No. 84, *p.* 143.
 - a.* Front view, natural size.
 - b.* Front view, magnified.
 - c.* Side view, ditto.
 7. *Marginella vittata*. No. 86, *p.* 144.
 - a.* Front view, natural size.
 - b.* Front view, magnified.
 - c.* Side view, ditto.
 8. *Marginella simplex*. No. 85, *p.* 143.
 - a.* Back view, natural size.
 - b.* Front view, magnified.
 - c.* Side view, ditto.



TAB. XIX.

Fig.

1. *Voluta nodosa*. No. 88, *p.* 148.

- a.* Back view of adult shell from Barton.
- b.* Front view of the same.
- c.* Back view of adult shell from Highgate.
- d.* Front view of ditto, ditto.
- e.* Back view of young shell from Bracklesham Bay.
- f.* Front view of adult shell, ditto.
- g.* Back view of ditto, ditto.
- h.* Front view of ditto, ditto.

Note.—Portions of the inner lip in the specimens, figs. 1*a* and 1*h*, are broken off.

2. *Voluta digitalina*, (Var. *lima*). No. 90, *p.* 151.

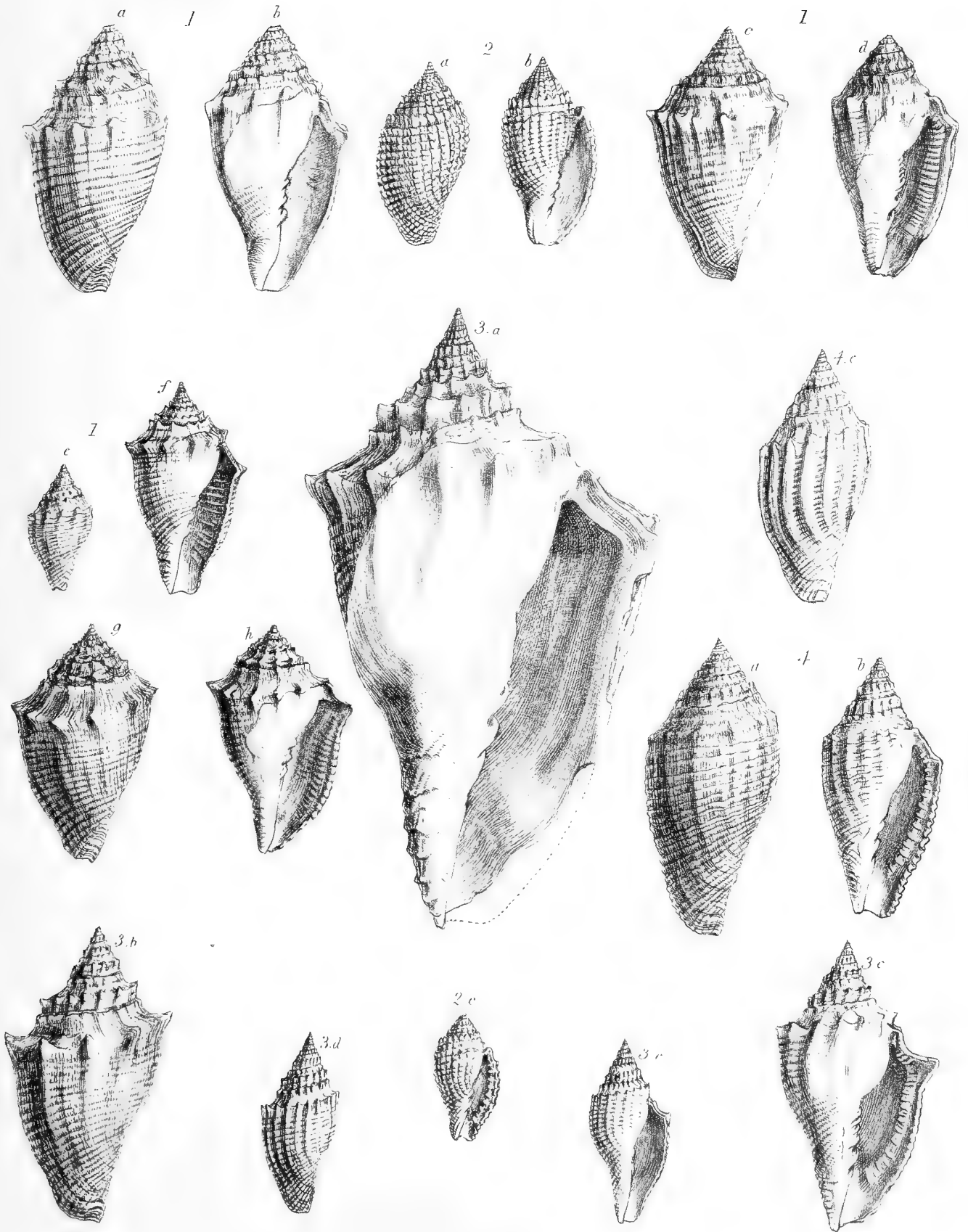
- a.* Back view, adult shell.
- b.* Front view, ditto.
- c.* Front view, ditto, with outer lip thickened and plicated.

3. *Voluta luctatrix*. No. 87, *p.* 147.

- a.* Front view, adult shell.
- b.* Back view, shell of mid-growth.
- c.* Front view, ditto.
- d.* Back view, young shell.
- e.* Front view, ditto.

4. *Voluta ambigua*. No. 89, *p.* 150.

- a.* Back view, adult shell.
- b.* Front view of the same.
- c.* Back view, (Var. *compressa*).

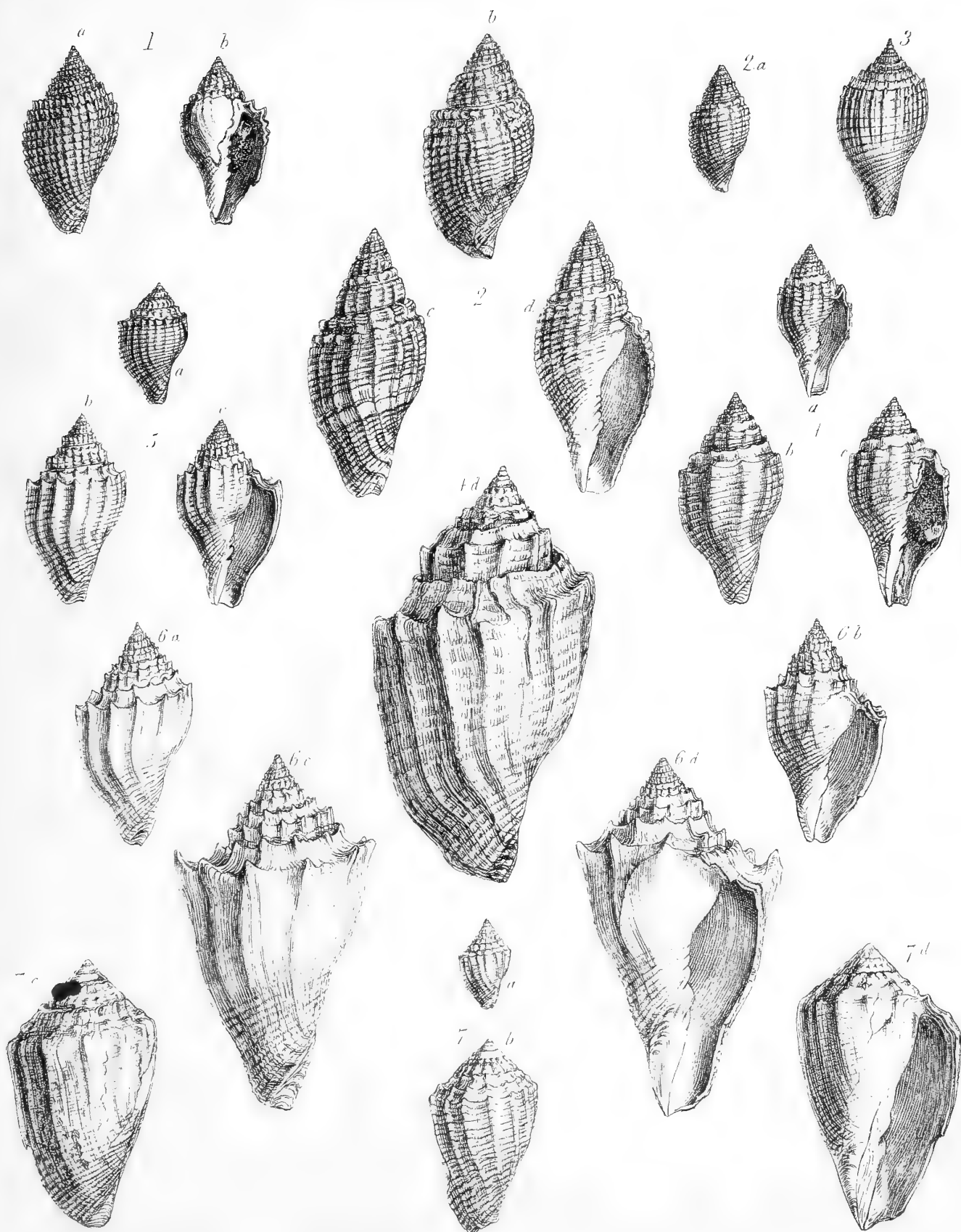


TAB. XX.

Fig

1. *Voluta crenulata*. No. 92, *p.* 154.
 - a.* Back view.
 - b.* Front view.
2. *Voluta elevata*. No. 91, *p.* 153.
 - a.* Back view, young shell.
 - b.* Back view, adult shell.
 - c.* Back view, adult shell from Southampton.
 - d.* Front view of the same.
3. *Voluta recticosta*. No. 95, *p.* 157.

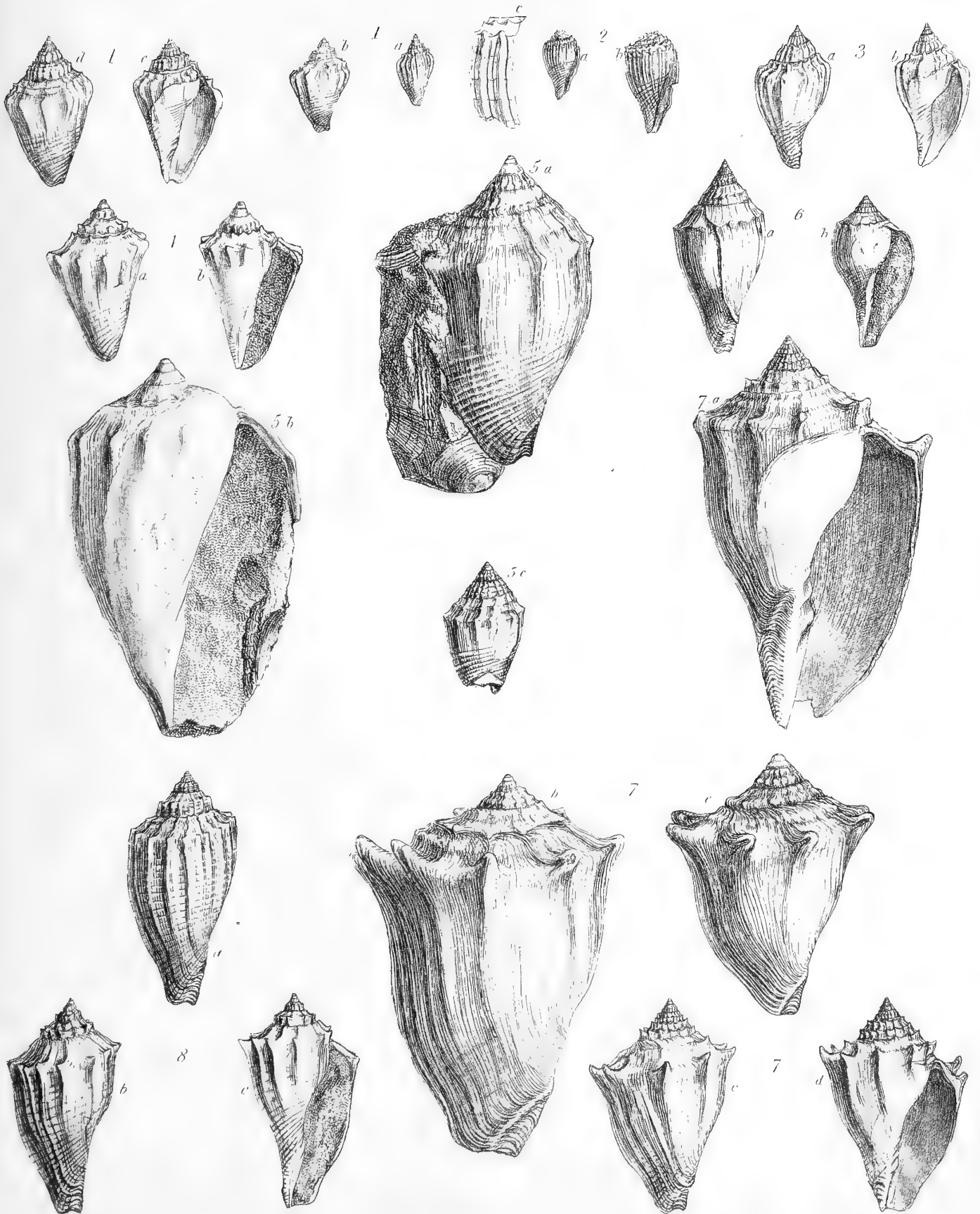
Back view.
4. *Voluta suspensa*. No. 96, *p.* 158.
 - a.* Front view, young shell.
 - b.* Back view, shell of mid-growth.
 - c.* Front view, ditto.
 - d.* Back view, adult shell.
5. *Voluta scalaris*. No. 94, *p.* 156.
 - a.* Back view, shell from Highcliff.
 - b.* Back view, shell from Barton.
 - c.* Front view, ditto.
6. *Voluta Solandri*. No. 93, *p.* 155.
 - a.* Back view, shell of mid-growth.
 - b.* Front view, ditto.
 - c.* Back view, adult shell.
 - d.* Front view, ditto.
7. *Voluta tricornata*. No. 97, *p.* 159.
 - a.* Back view, young shell from Primrose Hill.
 - b.* Back view, shell of mid-growth from ditto.
 - c.* Back view, adult shell from Copenhagen Fields.
 - d.* Front view, adult shell from Potter's Bar.



TAB. XXI.

Fig.

1. *Voluta Forbesii*. No. 105, *p.* 166.
 - a.* Back view, young shell, natural size.
 - b.* Back view, adult shell, ditto.
 - c.* Front view of the same, magnified.
 - d.* Back view, ditto, ditto.
2. *Voluta horrida*. No. 104, *p.* 166.
 - a.* Back view, natural size.
 - b.* Back view, magnified.
 - c.* Ribs, magnified.
3. *Voluta geminata*. No. 103, *p.* 165.
 - a.* Back view, adult shell.
 - b.* Front view, ditto.
4. *Voluta spinosa*. No. 101, *p.* 162.
 - a.* Back view.
 - b.* Front view.
5. *Voluta denudata*. No. 100, *p.* 162.
 - a.* Back view, shell of mid-growth.
 - b.* Front view, adult shell.
 - c.* Back view, young shell.
6. *Voluta calva*. No. 106, *p.* 167.
 - a.* Back view, adult shell.
 - b.* Front view, shell of mid-growth.
7. *Voluta athleta*. No. 99, *p.* 161.
 - a.* Front view, adult shell from Barton.
 - b.* Back view, ditto, ditto.
 - c.* Back view, shell of mid-growth, ditto.
 - d.* Front view of the same.
 - e.* Back view (Var. *Fortis*), adult shell from Highcliff.
8. *Voluta depauperata*. No. 102, *p.* 164.
 - a.* Back view, adult shell from Barton.
 - b.* Back view, ditto from Colwell Bay.
 - c.* Front view, ditto, ditto.



TAB. XXII.

Fig.

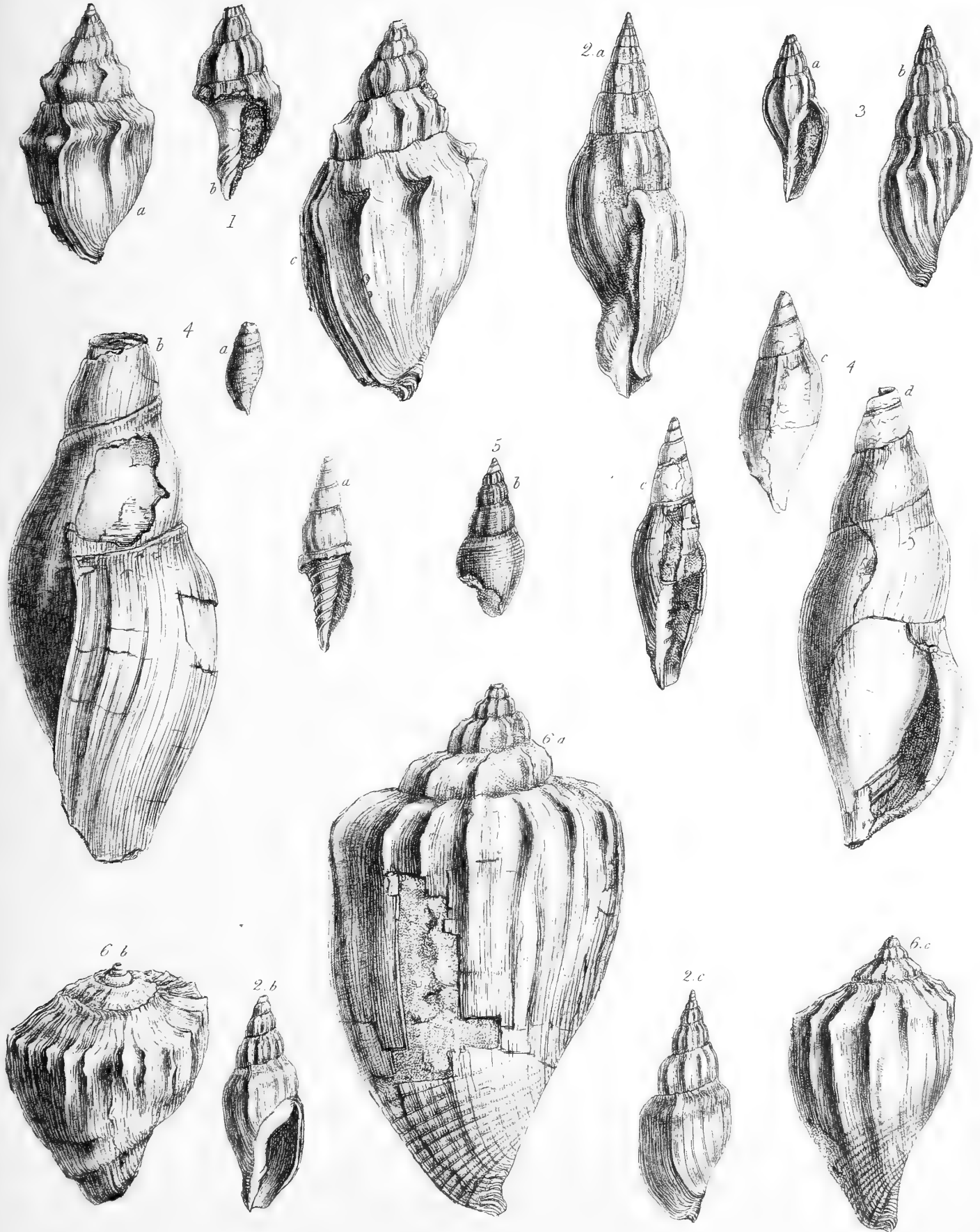
1. *Voluta pugil*. No. 98, *p.* 159.
 - a.* Back view.
 - b.* Front view.
 - c.* Back view, (Var. *platyspina*).
2. *Voluta maga*. No. 111, *p.* 172.
 - a.* Back view, young shell described in Min. Con., as to *V. harpula*.
 - b.* Front view of the same.
 - c.* Back view, young shell.
 - d.* Front view, shell of mid-growth (*V. Magorum* of Sow.).
 - e.* Front view, adult shell.
 - f.* Back view of the same.
3. *Voluta Selseiensis*. No. 107, *p.* 168.
 - a.* Back view, young shell (*V. bulbula* of Sow.).
 - b.* Back view, ditto.
 - c.* Front view, shell of mid-growth.
 - d.* Back view of the same.
 - e.* Front view, adult shell (*V. labrella* of Sow.).
 - f.* Back view, ditto.
4. *Voluta Branderi*. No. 112, *p.* 174.
 - a.* Back view, adult shell from Bracklesham Bay.
 - b.* Front view, French specimen of mid-growth.
5. *Voluta costata*. No. 109, *p.* 170.
 - a.* Back view, adult shell.
 - b.* Back view, shell of mid-growth.
 - c.* Front view of the same.
 - d.* Back view, young shell.
6. *Voluta humerosa*. No. 110, *p.* 171.
 - a.* Back view, adult shell.
 - b.* Front view of the same.



TAB. XXIII.

Fig.

1. *Voluta muricina*. No. 116, *p.* 178.
 - a.* Back view, shell of mid-growth.
 - b.* Side view.
 - c.* Back view, adult shell
2. *Voluta uniplicata*. No. 115, *p.* 177.
 - a.* Side view, adult shell.
 - b.* Front view, shell of mid-growth.
 - c.* Back view, ditto.
3. *Voluta angusta*. No. 108, *p.* 169.
 - a.* Front view, young shell.
 - b.* Back view, adult shell.
4. *Voluta Wetherellii*. No. 117, *p.* 179.
 - a.* Back view, young shell with the pullus.
 - b.* Side view, adult shell.
 - c.* Back view, young shell.
 - d.* Front view, adult shell.
5. *Voluta protensa*. No. 113, *p.* 175.
 - a.* Side view, shell from Whetstone.
 - b.* Back view, ditto.
 - c.* Front view, adult shell from Potter's Bar.
6. *Voluta cithara*. No. 114, *p.* 176.
 - a.* Back view, adult shell.
 - b.* Back view, (Var. *angulata*).
 - c.* Back view, shell of mid-growth.



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